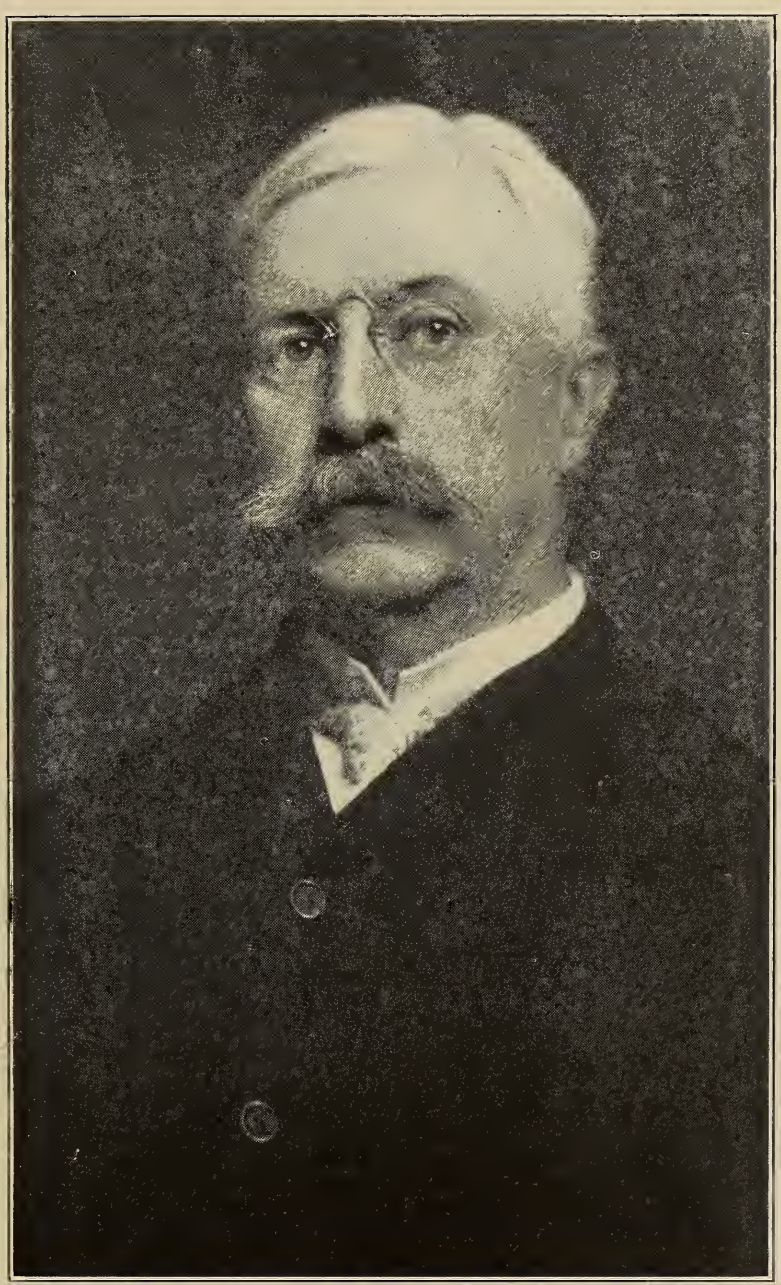


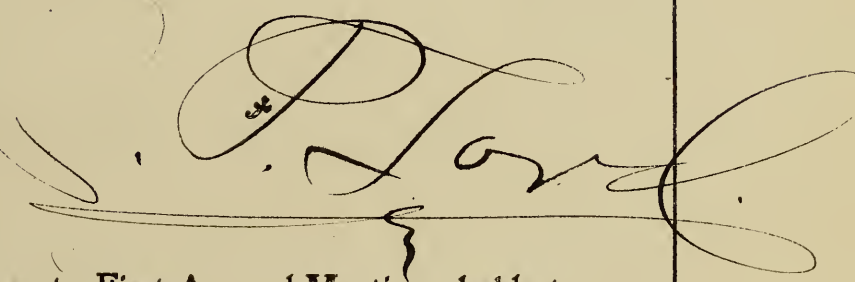
AMOS WILSON ABBOTT

PRESIDENT, 1911

TWENTY-FIRST ANNUAL MEETING

TRANSACTIONS OF THE

WESTERN SURGICAL ASSOCIATION



Twenty-First Annual Meeting, held at

Kansas City, Missouri, December 18 and 19, 1911

MINNEAPOLIS:
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OFFICERS AND EXECUTIVE COUNCIL, 1912

PRESIDENT

Lewis L. McArthur - - - - - Chicago

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Walter B. Dorsett - - - - - St. Louis

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John P. Lord, Chairman - - Omaha, Neb.

Arthur L. Wright - - - Carroll, Iowa

William W. Grant - - - Denver, Colo.

Charles W. Oviatt - - - Oshkosh, Wis.

Malcolm L. Harris - - - Chicago, Ill.

James E. Moore - - - Minneapolis, Minn.

CHAIRMAN COMMITTEE OF ARRANGEMENTS

William D. Haines - - - - - Cincinnati

EX-PRESIDENTS AND MEETING PLACES

PRESIDENT	PLACE	YEAR
S. S. Todd*	Topeka	1891
Milo B. Ward*	Kansas City	1892
Milo B. Ward*	Des Moines	1893
Lewis Schooler	Omaha	1894
John E. Summers, Jr.	Kansas City	1895
Thomas J. Beattie	Topeka	1896
Joseph Eastman*	Denver	1897
David S. Fairchild	Omaha	1898
Homer C. Crowell	Des Moines	1899
O. Beverly Campbell	Minneapolis	1900
August F. Jonas	Chicago	1901
James E. Moore	St. Joseph	1902
Alex. Hugh Ferguson	Denver	1903
Charles H. Mayo	Milwaukee	1904
Harvey D. Niles*	Kansas City	1905
Malcolm L. Harris	Salt Lake City	1906
Charles W. Oviatt	St. Louis	1907
William W. Grant	Minneapolis	1908
Arthur L. Wright	Omaha	1909
John P. Lord	Chicago	1910
Amos W. Abbott	Kansas City	1911

*Deceased.

The Western Surgical Association does not hold itself responsible for, or necessarily endorse, any of the papers printed herein.

ARTHUR T. MANN, Secretary-Treasurer.

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Executive Session

December 18, 1911—First Day—Morning Session

The Association met at the Coates Hotel, Kansas City, Missouri, and was called to order by the President, Dr. Amos W. Abbott, of Minneapolis, Minnesota, at 9:30 A. M.

Dr. Jabez N. Jackson, Chairman of the Local Committee of Arrangements, announced that at the conclusion of the morning session the local Fellows would tender the members and guests a luncheon at the Coates Hotel.

Dr. James W. Cokenower, of Des Moines, Iowa, read a paper entitled "The Pathology That Remains After the Non-surgical Treatment of Inflammation Within the Abdominal Cavity."

There was no discussion on this paper.

Dr. Miles F. Porter, of Fort Wayne, Indiana, read a paper entitled "Malignant Disease of the Hollow Viscera with Special Reference to the Diagnosis."

This paper was discussed by Drs. McArthur, Moore, Abbott, Grant, Percy, Harris, and, in closing, by the essayist.

Dr. Arthur E. Benjamin, of Minneapolis, read a paper entitled "The Early Removal of Gall-stones in the Preservation of the Gall-bladder as a Preventive of Disease of This and Contiguous Organs."

Dr. L. L. McArthur, of Chicago, read a paper entitled "Further Advances in the Therapeutic Utilization of the Bile Tracts."

These two papers were discussed together by Drs. Knott, Mann, Ritchie, and, in closing, by Dr. McArthur.

Dr. William D. Haines, of Cincinnati, Ohio, read a paper entitled "Some Phases in the Surgical Treatment of Gastric Ulcer."

The paper was discussed by Drs. Percy, Knott, McArthur, and, in closing, by Dr. Haines.

Dr. Albertius J. Burge, of Iowa City, Iowa, followed with a paper entitled "Report of Two Cases of Tuberculosis, Solitary and Apparently Primary, of the Fallopian Tubes."

The paper was discussed by Dr. Murphy.

Dr. C. Lester Hall, of Kansas City, Missouri, read a paper entitled "Fibrous Tuberculosis of the Peritoneum Involving the Omentum and Intestines and Uterus."

On motion, the Association adjourned until 2 P. M.

First Day—Afternoon Session

The Association reassembled at 2 P. M. and was called to order by the President.

Dr. Carl E. Black, of Jacksonville, Illinois, read a paper entitled "Inflammatory Displacements of the Colon."

The paper was discussed by Drs. Collins, Moore and Pearse.

Dr. Charles H. Mayo and Dr. Donald C. Balfour, of Rochester, Minnesota, contributed a joint paper entitled "Anomalies in the Rotation of the Colon," which was read by Dr. Edward S. Judd, in the absence of the authors.

These two papers were discussed by Drs. Eisendrath, Ruth, Abbott, Campbell, Macrae, Jackson, McArthur, Bowers, Benjamin, and, in closing, by Dr. Judd.

Dr. James E. Moore, of Minneapolis, read a paper entitled "Infection of the Retroperitoneal Glands."

Dr. Charles H. Wallace, of St. Joseph, Missouri, read a paper entitled "Strangulation of a Coil of Ileum beneath a Persistent Inguinogenital Ligament."

Dr. Van Buren Knott, of Sioux City, Iowa, read a paper entitled "A Suggestion in the Treatment of Acute Intestinal Obstruction with Impairment of Intestinal Vitality."

These two papers were discussed together by Drs. Harris, Nicholson, Griffith, Ruth, Christie, Grant, Haines, and the discussion was closed by Dr. Knott.

Dr. John B. Murphy, of Chicago, spoke on the subject of "Further Observations of the Regeneration of Bone and Reproduction of Joints," after which, on motion, the Association adjourned until 9 A. M., Tuesday.

The President, Dr. Amos W. Abbott, delivered his address at the banquet Monday evening. He selected for his subject "The Western Surgical Association."

DECEMBER 19, 1911—SECOND DAY—MORNING SESSION

The Association met at 9:30 A. M. and was called to order by the President.

Dr. Charles H. Lemon, of Milwaukee, Wisconsin, read a paper entitled "A New Apparatus for Reduction of Fractures of the Lower Extremity."

The paper was discussed by Drs. Bartlett, Moore, Harris, Fairchild, and, in closing, by Dr. Lemon.

Dr. William Jepson, of Sioux City, Iowa, read a

paper entitled "Traumatic Brain Abscess: A Consideration of Its Pathology and Management."

The paper was discussed by Drs. Grant, Davis, Eisendrath, Stokes, Ritchie, Basham, Fairchild, and, in closing, by the author.

Dr. Nathaniel Allison, of St. Louis, Missouri, read a paper entitled "Artificial Tendons and Ligaments in the Surgical Treatment of the Paralyses."

The paper was discussed by Drs. Eisendrath, Lord, and McArthur.

On motion of Dr. James E. Moore, a paper by Dr. A. H. Levings, of Milwaukee, entitled "Meningocele, Encephalocele, and Hydrocele: Their Cause and Treatment," was read by title in the absence of the author.

Dr. W. W. Grant, of Denver, Colorado, read a paper entitled "Infective Tenosynovitis."

The paper was discussed by Drs. Hertzler, Moore, Percy, and, in closing, by the essayist.

Dr. Daniel N. Eisendrath, of Chicago, read a paper entitled "Some Personal Experience in the Surgery of the Kidney and Ureter."

The paper was discussed by Drs. Harris, Jepson, and Lord.

On motion, the Association adjourned until 2 P. M.

Second Day—Afternoon Session

The Association reassembled at 2 P. M. and was called to order by the President.

Dr. Clifford U. Collins, of Peoria, Illinois, read a paper entitled "Nitrous Oxid Gas and Oxygen Anesthesia."

Dr. John L. Yates, of Milwaukee, Wisconsin, read a paper entitled "Some of the Effects of Anesthesia upon Toxin Resistance."

These two papers were discussed together by Drs. Abbott, Eisendrath, and, in closing, by Dr. Yates.

Secretary Mann presented the following report of the Executive Council:

REPORT OF THE EXECUTIVE COUNCIL

Kansas City, December 19, 1911

There were present at the first meeting of the Executive Council, Drs. Wright, Grant, Moore, Harris, Fairchild, and Porter.

There were present at the second meeting, Drs. Lord, Wright, Moore, Harris, and Fairchild.

The following are recommended as officers for the coming year:

President.....L. L. McArthur, Chicago
First Vice-President.....W. B. Dorsett, St. Louis
Second Vice-President.....M. B. Ricketts, Cincinnati
Secretary and Treasurer.....Arthur T. Mann, Minneapolis
Chairman Committee of Arrangements....W. D. Haines, Ohio

Executive Committee: Malcolm L. Harris and James E. Moore, to succeed themselves for one year.

After the banquet a telegram of sympathy was sent to Dr. C. H. Mayo at New York.

The following are recommended for membership:

Frederic A. Besley.....Chicago
E. Gard Edwards.....La Junta, Colo.
Charles N. Smith.....Toledo
Warren A. Dennis.....St. Paul
Allen B. Kanavel.....Chicago
Arthur A. Law.....Minneapolis
Edward C. Moore.....Los Angeles
Fred T. Murphy.....St. Louis
Reuben Peterson .....Ann Arbor
Henry H. Sherk .....Pasadena
Dean D. Lewis.....Chicago
F. H. McNaught.....Denver

Dr. Ellsworth Eliot, of New York, who read a paper by invitation at the Chicago meeting, is recommended as an honorary member.

The Treasurer's report was approved and is as follows:

RECEIPTS

Balance on hand, December, 1910.....	$664.07
Fees and dues to December, 1911.....	1,175.00
Extra banquet tickets for guests.....	80.00
One Vol. Transactions	2.50
Total	$1,921.57

DISBURSEMENTS

Paid for printing	$59.25
Paid expenses of Ellsworth Eliot, M. D., to the Chicago meeting	74.00
Paid Wm. Whitford for reporting the Chicago meeting	125.60
Paid for printing 250 vols. of the Transactions	586.40
Paid for honorarium to the Secretary	100.00
Paid for postage, express, etc	21.75
Paid for the banquet at Kansas City	325.00
Paid for refund on a banquet ticket	5.00
Paid for telegram to Dr. C. H. Mayo	.60
Total	$1,297.60
Balance on hand	$623.97
	$1,921.57

As a place of meeting for 1912 the Committee recommends either Denver or Cincinnati.

ARTHUR T. MANN, M. D., Secretary.

Cincinnati and Denver were voted on as places for holding the next annual meeting. There were twenty-seven votes cast for Cincinnati, and sixteen for Denver. Accordingly, Cincinnati was declared as the next place of meeting.

On motion of Dr. Daniel N. Eisendrath, seconded by several, the report of the Council was adopted.

Dr. Simon C. Beede moved that the Council be requested to publish the names of the members who have been dropped from membership, as well as the names of those who have been recommended for membership. Motion seconded and carried.

Dr. B. Merrill Ricketts, of Cincinnati, Ohio, read a paper entitled "Surgery of the Thoracic Lymphatics and Thymus, with a Demonstration of Intratracheal Insufflation on a Dog."

Dr. Edward S. Judd, of Rochester, Minnesota, read a paper entitled "Present Status of Surgery of Cancer of the Breast."

Dr. Arthur C. Stokes, of Omaha, Nebraska, read a paper entitled "Sarcoma of the Testicle, with Report of a Case."

Dr. James E. Percy, of Galesburg, Illinois, read a paper entitled "Results in the Treatment of Cancer of the Uterus by the Actual Cautery, with a Practical Method of Its Application."

These three papers were discussed jointly by Drs. Jackson, Hertzler, Jepson, Fairchild, Haines, Dorsett, Porter, Beede, and, in closing, by Drs. Judd and Percy.

Dr. Lawrence W. Littig, of Davenport, Iowa, read a paper entitled "The Technic of Tubal Sterilization."

Dr. B. B. Davis, of Omaha, Nebraska, read a paper on "The End-results of Gall-bladder Surgery."

Dr. John P. Lord, of Omaha, Nebraska, read a paper entitled "The Choice of Technic in Enterostomy Incident to Operations for Intestinal Obstruction."

Dr. James F. Percy, of Galesburg: A resolution was adopted this afternoon to the effect that the names of the members of this Association who have been dropped be published in the transactions. I think the Association ought to rescind that action, and I make a motion to that effect.

I do not think it is just to the men who have been dropped to have their names published in the transactions, for the reason that no explanation can go with it. I think Dr. Beede's original idea was to have the names read in the sessions of the Association.

Dr. Beede: It makes no particular difference to me, but I thought the members had a right to know what action in that respect was taken by the Executive Council.

The motion of Dr. Percy was seconded and carried.

On motion of Secretary Mann, a vote of thanks was extended to the Executive Council and the local Committee of Arrangements for having arranged for

and carried out one of the best meetings the Association has ever held.

On motion of Dr. B. B. Davis, a vote of thanks was extended to the retiring President, Dr. Abbott, for the efficient and impartial manner in which he has presided over the deliberations of the Association.

Dr. Abbott thanked the members of the Association for the uniform courtesy extended to him as presiding officer.

There being no further business to come before the Association, either scientific or otherwise, on motion, the Association adjourned to meet in Cincinnati, Ohio, in 1912.

President's Address

THE WESTERN SURGICAL ASSOCIATION

AMOS W. ABBOTT, M. D.

MINNEAPOLIS, MINNESOTA

The child of the wise foresight of our revered colleague, the late Dr. Ward, and fostered by his confreres, this Association, now passing its twenty-first birthday, has developed into a sturdy body whose shoulders' breadth stretches from the Pacific to the Great Lakes. In one direction it enjoys a cordial, tariff-free reciprocity with our Canadian brothers; and in the other, it finds a zealous co-laborer in our vigorous twin, the Southern Surgical Association.

A guild of searchers, as well as workers, it has not only grown in numbers, strength, and enthusiasm, but has done the better part in wisely and generously scattering, far beyond its own bounds, newly discovered grains which are already growing into a rich health-giving harvest. As indicated by the brilliant program and its enthusiastic reception, at this session, its energy is unabated. It has no scars of quarrels or abrasions of personal difference among its members. In fact, it has yet to admit an initial lesion.

Why has this Association been so satisfactorily successful? Why is its interest untiring, and its spirit still ardent?

We bring the results of months, perhaps of years, of work and lay it before you. You coolly pick it to

pieces, or cut it to shreds; and yet we come up smiling, and cheerfully go back to do some new work, and return, apparently hungry for the same treatment.

Where else would such total destruction of one's opinions be, I may say, so greedily invited? Why are we so eager to have our heads broken here when elsewhere we would resent a scratch?

The secret, I believe, is this: The criticism in this Association is not only honest, but capable.

Here the work, not the individual, is discussed. We feel that the criticism is just and that it comes from an authority equal to, and often higher than, our own. We come for the truth, and when you are through with us, we feel that we have it, and that, small as the footing may be, we know where we stand. No member of this Association would willingly fatten on an error that would do injury to his clientele. He wants to get at the absolute scientific value of his work. He has no vanity to sacrifice, but wants only to take back to his people facts on which he can depend. On the other hand, when your approval has endorsed his work, he is assured of its reliability, and is proportionately comforted and encouraged. These, I believe, are the chief reasons for the success of this Association.

There are some minor reasons: Our work is all original, and is submitted only after respectful preparation. Our meetings are not encumbered by protracted discussions of subjects outside of the program. Our business is transacted by an Executive Council which we wisely keep in office as long as possible, and in which we place implicit confidence. That confidence has never been betrayed. The political game which has almost wrecked many similar societies, has found no favor with us.

We are doing well. Can we do better? Early in the year your President, with the approval of the Executive Council, sent a note to all the members of the Association, asking for information as to any special work in which they were interested, and the results of which they desired to present here. This met with a prompt response, and a tentative program, giving such information, was mailed to each member. The object as stated was, first, to enable workers along similar lines to get in touch with each other; and, second, that this foreknowledge would be a preparation for discussion.

The purpose of this experiment (and we can only call it such) was not clearly understood by several of the members, as shown by their replies, and should perhaps have been more clearly stated; but the number and character of the replies that were received, indicated that a large part of the Association had formulated plans and were already at work for this meeting. This Association is especially adapted to the development of this plan because the membership is not too large, and each Fellow is not only an investigator, but in a wide field of practice puts to actual test the utility of what is suggested by his research.

The papers read before this Association are of the very highest order. Any improvement, in this respect, was therefore not in contemplation. It seems, however, that, knowing, at an early day, of the special work of each member, with the probability of its presentation here, the work of each might be enriched by material furnished from the experience of others. The chief object, however, was to give longer and better preparation for our discussions. If our discussions have lacked anything, it has been in the way of exact data and specific instances. Instead, we have too often submitted our general impressions, in the main undoubtedly correct but not having the value of the

data on which these impressions were founded, and which data might be open to a variety of interpretations.

Having in mind, months before our meeting, the topics to be discussed, experience in related cases would be more vividly impressed, and, indeed, notes might be kept with especial reference to such subjects. Our discussions are, as they should be, more of an interchange of views than of criticism, and therefore authoritative statements founded on data recorded at the time would be of the greatest value.

The discussion of this session has, apparently in greater measure, partaken of this quality, and to an equal extent has proved, in precision and accurateness, the merit of the experiment. Would it be asking too much that our incoming President give this plan another trial for the ensuing year, with such modification and correction as his wisdom may dictate?

THE PATHOLOGY THAT REMAINS AFTER NON-SURGICAL TREATMENT OF INFLAMMATION IN THE ABDOMINAL CAVITY

James W. Cokenower, M. D.

DES MOINES, IOWA

The tendency among some physicians and surgeons to relieve pain in the abdominal cavity and then make the diagnosis afterwards, has caused many serious mistakes, and I prefer giving a placebo and local applications in all acute abdominal pains until I have time to make a satisfactory diagnosis.

It is not the purpose of this brief paper to offer anything very new, but to emphasize the prominent features, with comments and conclusions on the subject.

The followers of modern rational medicine believe that actual disease within the abdomen, as in other parts of the body, always means a pathological condition, the removal or correction of which is necessary to restore normal health; and the efficiency of any treatment, for disease in this region, as elsewhere, should be estimated chiefly by the effect it has in removing or modifying the pathological condition producing the symptoms.

In the management of peritonitis, where the morbid processes are concealed beneath a rigid or distended abdomen, there are many temptations to lure us from

these teachings, and to do things which, in the light of the revelations of the modern operating-room, we must know are contrary to sound surgical principles. I believe we are prone to fall into these errors in our consideration of the remote dangers from inflammation within the abdominal cavity, and in doing so we find ourselves treating patients suffering with gall-stones for dyspepsia, and appendicitis is too often treated with local applications until the best time for operation is passed, and many other diseases in the abdomen treated along the same lines with disastrous subsequent results.

The prime effort seems to be to avert immediate danger, and we forget that the suffering and deaths from recurrent attacks and adhesions are vastly greater than in primary attacks, and the pathological conditions remaining after the non-surgical treatment of peritonitis are not a myth, but a reality which is directly responsible for this mortality and misery.

I believe 90 per cent of all survivors of the non-surgical treatment of peritonitis are left with infection without, as well as within, and with the latter, plenty of adhesions and the anatomical peculiarities of the gall-bladder, appendix, and Fallopian tubes favor the reception and imprisonment of infection from the alimentary canal and endometrium, and its extension to the peritoneum; and it is about one of these organs that we usually find the pathological condition, unless it has been mechanically removed, and the most virulent infection is appendiceal either from a cholangitis or from a gonorrheal salpingitis.

Since the infection of an appendicitis or a pyosalpinx has no outlet through natural channels, and in inflammation of the bile-ducts and gall-bladder there is usually some drainage through the common duct, we usually find, in the first-mentioned disease, that the local and general symptoms are pronounced and un-

mistakable, while, in the latter, especially in the absence of gall-stone seizures, the symptoms may be obscure and misleading, and when the infection reaches the outer coat of one of these organs, peritoneal adhesions are formed as a part of Nature's defense against the invasion of the microbic foe.

I believe that all fair-minded observers are learning to regard the pathological conditions within the abdomens of these patients as responsible for much distress and many deaths that formerly were attributed to other causes, and it is difficult to conceive how this or any other pathological condition within the abdomen and outside of the alimentary canal, can be removed by the application of drugs to the inner coat of the stomach or intestines or to the skin covering the abdomen, and it seems unreasonable that the gall-bladder, appendix, or Fallopian tubes can continue to harbor infection and the patient be exempt from those general and local symptoms that accompany imprisoned infection in other parts of the body.

The difficulty seems to be in making a correct and timely diagnosis, and if we would make it a rule in examining every patient who has had peritonitis and apparently recovered without the mechanical removal of the primary cause, to draw a line over the margin of each quadrant with additional oblique ones, if necessary, and then apply deep and direct pressure over the center of each of these lines, the existence and location of the pathological condition would nearly always be demonstrated.

When patients are suffering from symptoms that might be due to a mild toxemia of obscure origin, such as febrile and circulatory disturbances, gastro-intestinal disorders, headaches, fugitive pains, malaise, and others equally significant, we should always include in our examination those organs which are most likely to harbor the source of such systemic infection.

It is generally conceded that rheumatism is often associated with an appendicitis and peritonitis, as well as posterior urethritis; and it is a fact that rheumatism is not an uncommon result of septic absorption and must be counted as one of the not infrequent remote results of the non-surgical treatment of peritonitis.

The physiological functions of the stomach and intestines require the greatest mobility their anatomic attachments permit, and any band of adhesions that fixes, binds, or prevents their normal free movement, always means a departure from health, but these adhesions will nearly always be absorbed if the primary infection is completely removed; but no dietetic measures, drug-treatment, or rest-cure will prevent the formation of adhesions, or materially influence the absorption of those already formed, so long as the original infection is retained.

The presence of adhesions in operative work about the gall-bladder, appendix, or Fallopian tubes, is more reliable evidence of existing infection than any available microscopic or bacteriologic proof; and these adhesions produce symptoms so variable in intensity and so misleading in character, that, unless one is impressed with its frequent occurrence and bears in mind the anatomic and physiologic functions of the near-by organs, he is almost certain to attribute the symptoms to wrong causes.

The cracked lip, fissured nipple, and lacerated cervix seem to favor the development of cancer in those parts, as the locations selected for inflammation in the abdominal cavity, such as the pylorus, duodenum, rectum, cecum, etc., seem to mark the favored site of malignant disease. If these facts are true, we must count the pathological condition that remains after the non-surgical treatment of peritonitis as a strong one in favor of an early and correct diagnosis, and,

after that is done, we must govern ourselves accordingly.

I have compared the bedside and operative opinions and conditions, and it seems to me that we are just beginning to comprehend the remote results that follow the non-surgical treatment of peritonitis, and that no itemized list of symptoms produced by this infection and adhesions will give us the correct idea of the pathological condition and its bad results, and that our clearest conception must come from realizing its relative frequency, as compared with other morbid conditions within the abdomen, the history of one or more attacks, the results of palpation, and exclusion of other causative factors, combined with our familiarity with the anatomy and physiology of the parts involved.

Beyond the reach of drugs, electricity, massage, or dietetic measures, there is often a predisposition to abdominal symptoms or set of symptoms, from the mildest functional disturbances to those of well-marked malignancy, which must all be considered, especially by the surgeon called to decide whether or not an operation is indicated.

CONCLUSIONS

1. That pain in the abdomen is Nature's signal of distress and always means something, but should not be relieved to the extent that it will retard or prevent ascertaining the cause that produced it.

2. That infection in the abdominal cavity is not unlike infection in any other part of the body, and as soon as the diagnosis is cleared up the cause and pathological condition should be removed so far as possible, in any way that will give the best results.

3. That the non-surgical treatment of peritonitis is the cause of recurrent attacks of appendicitis,

cholecystitis, salpingitis, and, in fact, nearly all recurrent inflammations in the abdominal cavity producing an infected pathological condition.

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CANCER OF THE HOLLOW VISCERA OF THE ABDOMEN WITH SPECIAL REFERENCE TO DIAGNOSIS

MILES F. PORTER, M. D.

FORT WAYNE, INDIANA

According to the mortality statistics of the census of the United States for 1910, cancer ranks sixth on the list[1]. It is estimated that there are now in the United States 225,000 cases, this being an increase of 8,000 over 1908. There were 75,000 deaths from cancer in the United States in 1910. This means that annually one person out of every 1,200 in the United States dies of cancer.

According to Rodman[2] one-third of all cancers originate in the stomach. Stierlin[3] says of all deaths from cancer 3⅓ per cent are due to cancer of the rectum.

Without going into further detail, it may be said that we are warranted in claiming that between 40 and 50 per cent of all cancers originate in the hollow viscera of the abdomen. In this estimate, cancer of the urinary bladder is not included.

A vast majority of patients with cancer of the hollow viscera present symptoms of either obstruction or ulceration, or both, when first they consult the surgeon. This means that they come to the surgeon late, too late to achieve, through surgery, all the chances which it can offer of permanent cure.

The deaths from cancer of the hollow viscera are

very largely due to late diagnosis. Anemia, cachexia, and tumor are late signs of cancer.

E. C. Hort[4] regards a normal antitryptic blood-content as of great value in excluding a diagnosis of cancer. A raised antitryptic content, however, is present in measles, scarlatina, syphilis, and several other diseases. A raised antitryptic content seems to be of value in distinguishing between an innocent and a malignant neoplasm. Authorities differ as to the value of the hemolytic test.

The glycyl-tryptophan test involves too many sources of error to be of practical value. The value of the nitrogen content of the urine is still undetermined, according to E. Salkowske[5].

Where the diagnostic question is between gastric cancer and ulcer the finding of Gram-positive stools indicates that the case is one of cancer, according to P. H. Brown[6].

John B. Deaver[7] says there has not yet been discovered any specific serum or hemolytic reaction in patients suffering from cancer.

The gastroscope has as yet given us no practical aid in the diagnosis of gastric cancer. I have but little faith in the practical value of the *x*-ray bismuth test as an aid in the diagnosis of cancer of the hollow viscera. The *x*-ray bismuth test will demonstrate strictures and ulcers, but will not tell anything concerning their malignancy or otherwise. In other words, this method of examination will demonstrate only old surgical lesions. The routine use of the sigmoidoscope by the general practitioner, as well as by the surgeon, will result in a material improvement in the statistics of cancer of the rectum and sigmoid. Digital examination of the rectum with the patient standing will enable one to reach growths with the finger that cannot be detected with the patient in the recumbent position.

In the past too much attention has been paid to the so-called cancer age. The duration of cancer has been, and still is, in my opinion much underestimated.

Kocher says that most of the cases of rectal cancer are of two or more years' duration when he sees them first. This is my experience in all cancers of the hollow viscera excepting the appendix vermiformis. In the Rostock clinic four cases of rectal cancer out of a total of 115 occurred in patients between 14 and 17 years of age. In my own work I have seen many cancers in patients under 30 years of age. None of these, however, have been cancers of the hollow viscera. Schnitzler's[8] observations are interesting, but lack confirmation, and even if confirmed offer little hope, it would seem, of help in early diagnosis. He says that cancer of the stomach should always be suspected when the lymph-glands above the clavicle and in the axilla are large, hard, and not tender. Still more suspicious of cancer of the stomach, he says is an infiltration in the pouch of Douglas. He has not seen metastasis in the pouch of Douglas in connection with cancer of the other hollow viscera, but has seen it in one case of pancreatic cancer.

Why is it that the prognosis in cancer of the appendix is relatively good? In my judgment it is because the rule is to open the belly on the slightest provocation from symptoms in the right lower quadrant of the abdomen, and to remove the appendix on suspicion.

Voeckler[9] accounts for the relatively good prognosis in cancer of the appendix on the ground that inflammation of the appendix makes its presence known very early. This is only a partial statement, however. The fact is that we not only recognize inflammation of the appendix early, but we remove it as soon as we know that it is inflamed.

Mistakes in diagnosis are frequently made, even after inspection through the open belly.

In a paper read at the recent meeting of the Southern Surgical and Gynecological Association on the subject of "Cancer of the Rectum and Lower Sigmoid," I refer to four cases in which innocent disease of the colon was mistaken for malignant disease. One each of these cases occurred in the practice of Drs. McCosh, Brewer, Stimson, and the writer.

The difficulty of diagnosing between malignant and non-malignant conditions of the bile-tracts, even with the belly open, is well known.

Rolleston[10] reports two such cases in his own practice. In one, malignancy was supposed to exist and did not, and in one the trouble was thought to be inflammatory and proved later to be malignant.

Twice I have mistaken benign changes consequent upon cholelithiasis for malignant disease. In one case the belly was closed after simple exploration. A post-mortem examination, made some months later, developed the fact that the trouble was inflammatory and consequent upon a large gall-stone lodged in the ampulla of Vater. This case occurred twelve years ago. Today, in such a case, I would drain the liver through the abdomen and later attempt a radical cure. The second case is as follows:

Case 1.—Mrs. F., aged 62, housewife, American, was admitted to Hope Hospital, August 3, 1910. Family history: One sister died of cancer, one of tuberculosis, and one of "uterine tumor." Previous history: Negative, save that she frequently suffered from "indigestion." The present trouble began about three months ago with severe pain in the right side and back, in the liver region, accompanied by nausea and constipation. She has had several similar at-

tacks since the first one, the last occurring two days ago. She has been in bed two weeks.

Examination showed slight jaundice, considerable loss of flesh, temperature normal, pulse 90 per minute. There was a tender mass in the gall-bladder region. Operation revealed a gall-bladder distended with mucoid fluid, slightly bile-stained, and containing a large mulberry stone, which was removed. The liver was distinctly nodular and hard. The gall-bladder was drained. The family was told that the trouble was probably malignant, and that only temporary relief was to be expected. Now, fifteen months after the operation, the patient is well.

An instructive case wherein non-malignant disease of the stomach was, at the time of operation, considered to be malignant is the following:

Case 2.—Mr. B., aged 44, merchant, single, was admitted to Hope Hospital, April 19, 1907. Family history: Negative. Previous history: Had suffered ten years with attacks of indigestion. These attacks were characterized chiefly by recurring pain and discomfort in the epigastric region. Vomited at times, but never vomited blood. Latterly the discomfort has been continuous and the vomiting more frequent. He has been confined to the house ten days and to the bed four days.

Examination: Patient is much emaciated and cachectic. There is a mass, somewhat tender, and very hard, in the region of the pylorus. Operation, April 20, 1907: The usual incision revealed an irregular hard mass in the pyloric end of the stomach, which was adherent to everything in the vicinity. The lymphatics were enlarged. A posterior gastrojejunostomy was done, and the opinion given that the trouble was malignant, and that the operation would be only palliative. At the present writing the man is in perfect

health, now four years and eight months after the operation.

Case 3.—Mr. R. H. C., a married farmer, aged 47, was admitted to the hospital, October 25, 1911.

Family history: Two paternal aunts and one son died of tuberculosis. Previous history: Typhoid fever twelve years ago. Has been subject to frequent bilious attacks all his life. Lately the intervals between these attacks have grown shorter. Fifteen months ago during one of these attacks two gall-stones were passed. Vomitus is green, slimy, and bitter. Never vomited any blood. Has lost fifteen or twenty pounds in the last few months. Present history: This attack came on with severe pain in epigastrium and vomiting of "slime and bile." Bowels constipated.

Examination: Small, poorly nourished, medium complexion. Lungs and heart, negative. Abdomen is scaphoid, and the walls very thin. An indistinct mass was felt above and slightly to the right of the navel. A probable diagnosis of cholecystitis was made. Operation October 26, 1911: Vertical incision through right rectus. Pylorus and duodenum were found adherent to under surface of the liver and to the gall-bladder. Pylorus was patulous and stomach-walls apparently healthy. The head of the pancreas was enlarged and adherent to the posterior aspect of the pylorus. The gall-bladder was opened and found to contain thick, stringy, dark bile containing many granules, but no stones were found. Under the impression that I was dealing with an infection of the bile-tracts which had caused a pancreatitis the gall-bladder was drained and the wound dressed in the usual way. The patient did well for five days, when he complained of severe pain in the stomach and vomited. The vomitus contained some changed blood, and on the same day the patient had two rather copious dark-brown liquid stools. The pulse now be-

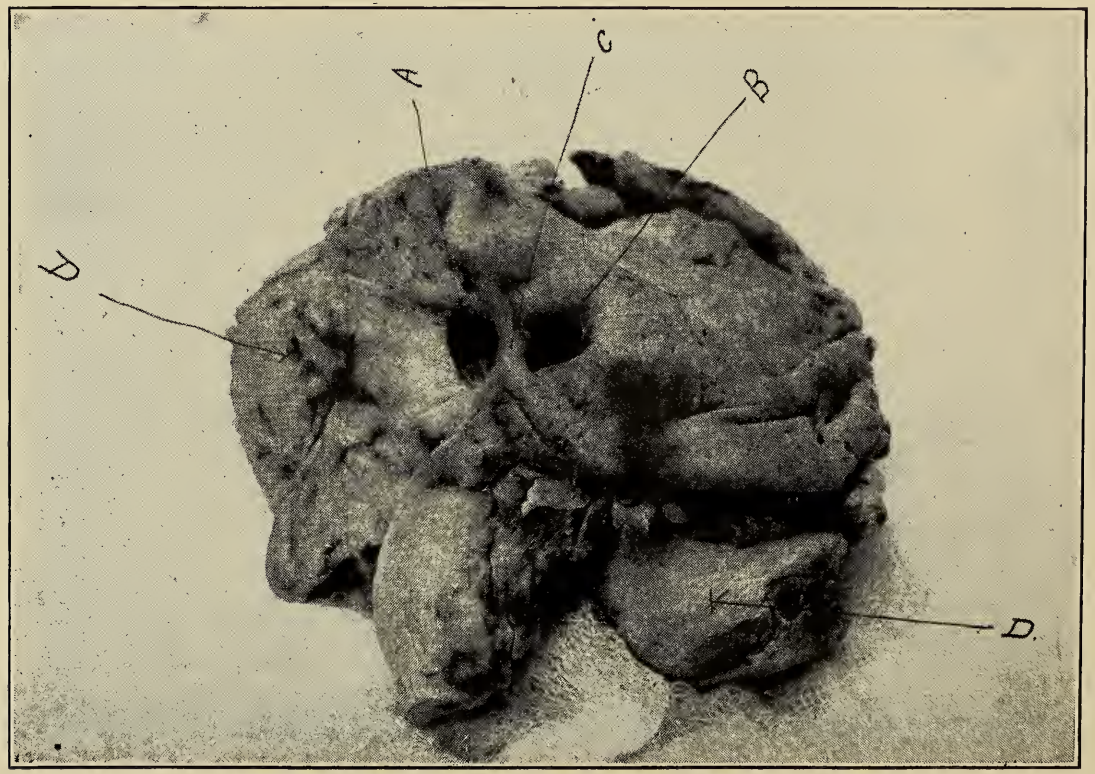

FIG. 1. Photograph of specimen taken from Case 3. (R. H. C.). Looking at the mucous surface there are apparently two ulcers (A and B) separated by a band (C); however, the two cavities communicate under the band (C). The band is composed of normal muscular tissue covered with normal mucous membrane. The floor of the ulcer is formed by the pancreas, which is hard and enlarged in this region (the head). D D pancreas. Duodenogastric ulcer. B, stomach side. A, duodenal side. C, pyloric muscle.

came weak and rapid. Within twelve hours of the onset of this attack the patient was feeling quite comfortable, and the pulse had dropped from 136 to 100 and had improved in character. From this time on the patient vomited occasionally.

Sometimes only the food taken would be vomited and sometimes there would be blood in the vomitus. A day or two or a longer time would elapse, during which the patient was quite comfortable and took food without distress. On the eighth day after the operation it was noted that there was some blood on the dressing. Total rest of the stomach seemed to be of no avail. The patient died of a severe hemorrhage on the twenty-fifth day after the operation.

Post-mortem examination revealed what might be termed a saddle ulcer of the stomach and duodenum with one skirt of the saddle in the stomach and the other in the duodenum, and the two skirts communicating beneath the pylorus. This pyloric band which crossed the ulcer was perfectly soft, flexible, and apparently normal. The stomach and duodenal walls up to the margin of the ulcer seemed perfectly normal.

The pyloric end of the stomach and the commencement of the duodenum, together with the head of the pancreas, were removed *en masse,* and before the pylorus was opened I attempted to pass my finger through it, when I discovered apparently two pyloric openings; one in front, normal, and one, posterior, strictured, and non-distensible. Not until the specimen was split along the anterior wall was this finding made clear.

The cavity of the ulcer was filled with a blood-clot, which, on removal, was dumb-bell in shape. The floor and side walls of the ulcer were formed by the pancreas. The head of the pancreas was enlarged and hard, and the pathologist's report was "interstitial

pancreatitis with some autodigestion." Fig. 1 is made from a photograph of the specimen and will give a clear understanding of the conditions.

REMARKS

Looking backward, one sees perfectly clearly that this patient's belly should have been re-opened and a posterior gastrojejunostomy done as soon as he rallied from his first hemorrhage. The advisability of a second operation was discussed with my confreres, but it was not done, because at the first operation the pylorus was found patulous and distensible and the head of the pancreas enlarged and hard. Moreover, there was also demonstrated at that time a cholecystitis and pericholecystitis. These findings, taken together with the previous history and the first five days of the post-operative history, led me to conclude that we could rule out gastric ulcer and probably had to deal with a pancreatic trouble, malignant in character.

This opinion seemed strengthened also when on the eighth day after the operation the dressings were found quite bloody. I want to say here that this is to be taken as an explanation, pure and simple, of how I was led into grievous error and not as an excuse or plea for leniency. In fact, one of the chief objects of this paper is to do what I can to make it unnecessary for others to learn by experience, for " 'tis true, 'tis pity, and pity 'tis 'tis true," but the fact remains that when one says he has learned by experience it is only another way of saying that he has learned from his mistakes.

CONCLUSIONS

1. The symptoms commonly regarded as sufficient to warrant a diagnosis of cancer of the hollow viscera are such as are not manifest until the favorable time for surgical interference has passed.

2. Success in the treatment of cancer of the hollow viscera depends largely upon its early recognition.

3. It is often unsafe and unwise to make a diagnosis between malignancy and benignancy without the aid of the microscope.

4. The way to improve our results in the surgical treatment of cancer of the hollow viscera lies in the direction of earlier celiotomy and immediate microscopic examination of the specimen.

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DISCUSSION

DR. L. L. MCARTHUR (Chicago): Spencer Wells once read a paper before the British Medical Association, the title of which was "The Necessary Errors in Diagnosis." From just such cases as have been cited by the essayist, we cannot see how other logical deductions could be made than those that have been made by him. The errors in diagnosis which are not necessary, however, are those which he is endeavoring to again call to mind. I take it, his aim is to re-emphasize, if possible, the need of careful investigation of any simple complaints a patient may make, with early interference as soon as there is justification from these complaints and after a careful examination has been made.

I want also to urge the use of the erect posture for examination, particularly when digital examination is being made for rectal carcinomatous disease that has been suspected, and especially to urge that which, I feel pretty sure, most of us do not use, namely, the sigmoidoscope. In my hands the more efficacious is the one with the electric light within its lumen at the deeper end of the instrument rather than the

head-mirror. The latter rarely gives you an illumination that is satisfactory, whereas the electric light within the sigmoidoscope does.

In the use of this instrument, unless one has been instructed in it, I think many failures obtain because of the non-compliance with the instructions of those who have most used it. Until I had seen it used abroad I did not know how to use it. The secret of success in its use, I believe, is the most exaggerated possible genupectoral position. In that position air enters the bowel readily, and if the bowel is capable of dilatation sufficient to admit the sigmoidoscope, it will then enter, and under observation with the electric light at its distal end one can pass it up to and into the sigmoid and see sometimes even the second portion of the sigmoid. Tumors that absolutely cannot be palpated, such as small carcinomata of the sigmoid, are thus discovered.

In the paper reference was made to the finding of the episternal glands as a means of diagnosis of carcinoma of the stomach, those that occur along the common thoracic duct; and reference was also made to the feeling of masses in the rectum through the rectal wall in the pouch of Douglas when suspecting carcinoma of the upper abdomen. These things, it is true, are very positive evidences of carcinoma of some one of the abdominal organs, but equally positive evidence of the hopelessness of the case when they are found.

Dr. James E. Moore (Minneapolis): When we arrive at perfection in diagnosis, human fallibility will have disappeared, and we shall be enjoying the millenium. However, it behooves us to arrive as nearly at perfection as possible in diagnosis. Such papers are generally helpful.

While I would not for a moment pose as an advocate of making the diagnosis by means of the knife, it does seem to me that future progress must be made, as Dr. Porter suggests, by undertaking timely exploratory operations. I do not mean that these exploratory operations should be made by every family physician in the land, but I do mean they should be made when a pathological condition is suggested in the abdominal cavity, and should be made by men who know a pathological condition when they feel it and see it.

Speaking of the feeling of a pathological condition, it is difficult to differentiate between a benign and a malignant growth when we have it between our fingers. This is particularly true of the hollow viscera; yet I maintain that, when a case is sufficiently grave to justify exploration, we are

perfectly justified in taking out a piece of the growth, making a frozen section, and establishing an absolute diagnosis at the time. It seems to me that we are gradually arriving at greater accuracy in diagnosis, but we all admit our limitations, and that this is one of the most inviting and one of the most necessary fields for experimental and exploratory work for the rising generation of surgeons.

Dr. Amos W. Abbott (Minneapolis): I wish to call attention to an easy way of examining the rectum in cases of suspected carcinoma, and that is in the use of the ordinary 10 mm. Kelly cystoscope, which is so small that it does not give the patient any inconvenience whatever. One can get as good a view of the bowel with it as by the larger proctoscope under ordinary circumstances, and patients do not object to it in any way. The important point is to get the patient in the right position, as Dr. McArthur has pointed out. Put the patient in the knee-chest position, insert the cystoscope, and distract his attention by asking him to hollow his back as much as he can. As he lets the abdomen sag, the air rushes in, and a good view above the valves is ordinarily obtained. It is a simple little thing, but very practical.

Dr. W. W. Grant (Denver): Dr. Porter has very justly called our attention to the one important and essential fact concerning better results in these cases, and that is an earlier diagnosis. The fact that the physician or the surgeon knows nothing of these cases, and has not had an opportunity for any examination until the disease is far enough advanced to produce distinct clinical symptoms, often shows that it is too late even then to safely predict a good result from operative intervention. The truth comes, not alone from our instruments of scientific precision, for at present they are indefinite and uncertain, but from a closer study of the clinical history of these cases by the physician, and until that time comes and we have better diagnosticians and better clinicians, we shall perhaps not have early diagnoses and better results in the treatment of cancer of the hollow viscera. In a disease so insidious in its character as cancer of the intestines, free in the early stages from pain, not until the symptoms of stricture or other intestinal disturbance in the form of mucus and blood are manifested, are we called upon to make a careful scientific examination of patients, and yet a close study of the clinical history of these cases will often enable one to determine, or point out, the necessity of early, careful examination, either by the sigmoidoscope, as in cases of sigmoiditis, which are

not always by any means malignant, or in the early stages of growth of the sigmoid, which may have existed for two or three years of a malignant character and give rise to distinct symptoms. It is true that if the family physician is a diagnostician there will be sufficient evidence at an earlier period which will determine the necessity of a scientific examination and consequently an earlier diagnosis, and an earlier resort to surgery; and better results will then be obtained from the treatment of this most formidable and malignant disease at this time. It is also a fact that many cases of supposed carcinoma of the pancreas often prove by operation and drainage of the gall-bladder to be nothing but a chronic interstitial pancreatitis, and also a condition which is not always easily determined at an early stage,—a pancreatitis.

The result, as shown by Dr. Porter, of recovery of the patient, is always conclusive proof that the disease was not malignant, but a chronic interstitial pancreatitis, which is cured by relieving the infected gall-bladder which was the cause of it.

I therefore would appeal to the profession to give more attention to the study of diagnosis, regardless of the instruments of scientific precision, to study these cases carefully at their homes; and, if this is done, we shall have earlier diagnoses and a better and more successful treatment of visceral carcinoma.

Dr. James F. Percy (Galesburg, Ill.): The essayist has suggested that, if he could have recognized the ulcer that was bleeding and had done a posterior gastro-enterostomy, he might have saved his patient.

I have had a similar experience to the one reported in which a posterior gastro-enterostomy was done. The ulcer, in my case, was situated in the pylorus, and nature had made an attempt to close it by adhesions to the liver. The patient did well for four or five days, if I remember correctly—at least long enough so that I felt he was going to make a good recovery, but that day he suddenly had a furious hemorrhage, vomited two or three basinfuls of blood, and died.

I question whether—and that is the point I rise to make—a posterior gastro-enterostomy in these large ulcers is going to save our patients, especially where the ulcer cannot be excised, as in my case, without doing too much surgery.

Dr. M. L. Harris (Chicago): Until some specific reaction is discovered, the diagnosis of cancer in all of the internal

organs, those not subject to direct investigation by the microscope in their inception, is entirely one of probability. The most essential point in determining the degree of probability is the recognition of the frequency of cancer. Of all women who have reached the age of forty-five, one out of ten will inevitably die of cancer, and of all men who have reached the age of forty-five, one out of sixteen will die of cancer. Of the men who die of cancer, fifty per cent will be in the stomach. Of the women who die of cancer, fifteen per cent will be in the stomach. We start out, then, with the proposition that in all patients who reach the age of forty-five, who have a morbid condition of an internal organ which is continuous, there is a strong probability of cancer. If, in starting out with this great probability we eliminate those conditions, which we are able to do by positive diagnostic means, we still have a condition that is persistent and is progressive in spite of the best treatment which we may institute, there is a high degree of probability that the case is one of cancer. In fact, the probability is so great that the case demands an immediate exploratory operation to determine whether or not we have to deal with cancer. Until we recognize that the diagnosis is one entirely of probability, and until we resort to immediate exploratory operation, in order to clear up the diagnosis, we shall not get these cases in the early stages.

Dr. Porter (closing the discussion): The only point in connection with this case was this: We took the position that, in all probability, we had to deal with cancer, and proceeded on that ground, and made an exploratory operation early, and if we did that more frequently, as we do now in connection with the appendix, I am sure we would achieve the results we are after.

Dr. Grant: Give your opinion of the suggestion made by Dr. Moore as to the advisability of making a frozen section in suspicious cases, in order to establish the diagnosis, and the necessity of operation.

Dr. Porter: I think it is necessary to make a frozen section in these suspicious cases, for, as I stated in my paper, I do not believe any man can tell the difference between malignancy and non-malignancy in a great many of these cases with the unaided organs of investigation. I do not believe it is possible. Certain it is, the very best of men have made mistakes regarding the malignancy or non-malignancy of tumors. I believe a frozen section should always be made, if possible;

and if this is done, it will prevent a whole lot of radical operations for which might be substituted operations that are less risky, less radical, and equally good in their results. It would prevent us from closing many of them without any attempt at relief under the impression that we had to deal with inoperable malignant disease.

In this connection, it might be well enough for me to say that I had brought into the hospital an old woman to be operated on for obstruction of the bowels. All I could do at this time was to open the bowel and give immediate relief, and incidentally in doing so I concluded she had an inoperable carcinoma of the sigmoid; I consequently divided the sigmoid, closed the lower end of the gut, dropped it inside of the abdomen, and brought the other part out with the idea that I would relieve the woman for a few weeks. The fact of the matter is, with reference to this case, that the woman is perfectly well now, the operation having been done years ago. This case I reported in detail in connection with a recent paper, in which I also reported similar experiences occurring in the practice of Drs. McCosh, Brewer, and Stimson.

THE EARLY REMOVAL OF GALL-STONES AND THE PRESERVATION OF THE GALL-BLADDER AS A PREVENTION OF DISEASE OF THIS AND CONTIGUOUS ORGANS

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It is the general opinion today that gall-stones are the result of gall-bladder infection due to bacterial invasion from the intestines, gaining entrance by the portal circulation or possibly through the common bile-duct. Infectious microörganisms are carried into the liver substance and then find their way into the gall-bladder with the production of an inflammation of the mucous membrane, which results in the formation of gall-stones. In many instances a severe infection may produce cholecystitis with a formation of mucus and pus, and, in some instances, with ulceration and gangrene and perforation of the gall-bladder wall. Gall-stones are a late product of infection. One of the most important diseases which causes infection of the gall-bladder by the bacilli carried through the portal circulation is typhoid fever. A diseased appendix is a frequent factor in the production of gall-stone disease. It is, therefore, not uncommon to find gall-stones associated with appendicitis.

DIAGNOSIS

The belief that gall-stones are unproductive of serious symptoms or complications, has been quite

prevalent because of erroneous statements made by physicians to this effect: "This belief, together with the fact that gall-stones have not been diagnosed prior to the onset of complications, has resulted in gall-stone surgery becoming largely the surgery of terminal events." The symptoms of indigestion, biliousness, and neuralgia and gastralgia, in a great majority of instances, can be traced to cholecystitis or cholelithiasis. The knowledge of gall-bladder disease and the experience of the surgeon and the general practitioner are increasing rapidly, and, ere long, this organ will have received the careful and deserved consideration that the appendix now receives.

WHEN TO OPERATE

English and American surgeons are more decided in their views as regards the operative necessity for gall-stones. Continental surgeons, with the exception of Riedel, are most conservative and wait for decided and serious symptoms to arise before they advocate surgical measures. Some agree that the operation should not be undertaken while the disease is local, but when such symptoms as empyema, chronic infection, adhesions, and symptoms of stones fixed in the ducts, are present, an operation is undertaken.

According to Kehr, the majority of gall-stone cases present no indication for operation. As he naively puts it, "Of 4,000 cases only one-third (1,300) have felt the edge of my knife" (der Scharfe meines Messers). A study of the remaining non-operated cases has led him to the conclusion that cholelithiasis tends to latency in about 80 per cent.

Goldemar would operate in acute infectious cholecystitis or recurring attacks of cholecystitis, in hydrops, chronic empyema, chronic obstruction of the common duct, in severe and repeated attacks of pain, cholangitis, liver abscess, perforated peritonitis, and

in secondary changes in the stomach or intestine. He considers that the infection and inflammation call more for the operation than the presence of a stone.

EARLY OPERATION

While admitting that early operation will avoid many of the complications of gall-stones, surgeons are often loath to advocate it. Gall-stones are not normal residents of the gall-bladder. They are the product of disease and are a constant menace to the healthful function of the biliary, as well as the gastro-intestinal, tract. Why should so much precious time be lost in temporizing or compromising with infection and its offspring, gall-stones? Thousands of lives are lost annually, owing to ignorance and lack of prompt and timely attention by surgical intervention.

Moynihan has expressed himself as decidedly in favor of early operation, as soon as the presence of gall-stones can be diagnosed.

Richardson says that early gall-stone surgery, in skillful hands, is so safe that it seems worthy only of condemnation to employ methods other than surgical at the early period when operation is easy.

Although it is customary to speak of early operation, I would say, as Deaver points out, the surgeon who removes stones, is operating comparatively late in the disease, since these are found after an unknown, but probably long, lapse of time, and the occasion for medical measures has long since passed.

Every attack of gall-stone colic adds to the danger and the disease present and production of complications. Few cases recover spontaneously. Small incisions can be made, as the stones are usually in the gall-bladder. It is not necessary to remove the gall-bladder in early operation.

The mortality is very small when operation is done before complications arise. Mayo states that the mortality in early operation is 3 per cent, while that of operations when the stones are in the common duct is about 11 per cent. In 4 per cent malignant disease is discovered when the operative mortality is 22 per cent.

The difficulty and danger of an operation when the stones have migrated to the common duct are strong arguments for an operation when they are still in the gall-bladder.

Continental surgeons, for some unaccountable reasons, have not yet recognized the extreme necessity of early operation in gall-stone disease.

Kehr would operate only on latent stones or where cancer is suspected, or where stones are lodged in the ducts or cholangitis exists.

The surgeons in America in general have begun to associate with gall-stones of long standing pancreatitis, cancer, fistulæ, adhesions, cholangeitis, empyema, liver abscess, hemorrhages, subphrenic abscesses, gangrene of the gall-bladder, and local peritonitis and nephritis and diabetes in some cases. Empyema of the gall-bladder is possible where the cystic duct is obstructed and rupture of the organ is not uncommon. They are, therefore, attacking disease of the gall-bladder early, thereby avoiding any of the above-named sequels.

An inflammation in the gall-bladder ducts or tissue around these structures due to the migration of infectious microörganisms through their walls, results in adhesions of the contiguous organs involving the colon, duodenum, or small intestine.

An interference with the motility of the stomach and the emptying of its contents, produces gastritis, and chronic dilatation of that organ is not infrequent.

The association of the common and pancreatic ducts is such that a stone lodging in the ampulla of Vater will obstruct the duct of Wirsung, blocking the exit for the pancreatic juice, and allowing the retrojection of bile from the common duct into the canal of Wirsung.

In the presence of stone infection is more probable, as the traumatism of the stone causes erosion and absorption of infectious microörganisms at these points, with swelling and enlargement of the lymphatics along the course of the ducts, often simulating stones.

CHOLECYSTECTOMY VERSUS CHOLECYSTOSTOMY

The gall-bladder has been likened to the appendix by a large number of leading surgeons who have advocated its removal when diseased, but, in so doing, they have not reckoned with other dependent and contiguous and associated organs. The rôle played by the gall-bladder in pancreatic disease has not been very thoroughly understood. The functions of the gall-bladder and pancreas are interdependent. For the proper function of the liver, gall-bladder, duodenum, stomach, and pancreas, a healthy state of all these associated organs must be present. Without one of these component parts of this system the functions of all are usually faulty. We must therefore endeavor to eradicate diseases involving one or more of these associated parts in a way which will leave them all intact and able to perform their functions normally, and unless there exists a condition making a gall-bladder permanently useless it should at all times be saved.

There is a notable difference of opinion as regards the advisability of removing the gall-bladder when diseased. Here again we find Continental surgeons advocating the more radical procedure, as we

might expect, when they allow the more serious complications to arise before an operation is performed. The gall-bladder is, by necessity, sacrificed oftener by these men.

Delageniere removes the gall-bladder in wounds, ruptures, gangrene, chronic cholecystitis with stenosis of the common duct, over-distension of the gall-bladder due to stone in the common duct, and cancer.

A few years ago a number of notable American surgeons were removing the gall-bladder, but at the present time they are preserving it.

Pathologists and clinicians have found that with acute and chronic gall-bladder disease there often exist a cholangitis, congestion of the liver, jaundice, and pancreatic affections, and that drainage is an all-important necessity, and that it can best be permitted by saving the gall-bladder for that purpose. It is surprising in how many cases the gall-bladder will regain its normal function when properly drained. Even with stricture of the common duct, hydraulic pressure often facilitates the flow of bile into the duodenum. In suppurative cholangitis it is of vital importance to preserve the gall-bladder.

It has been found that 20 per cent of common-duct stones form in the liver, the gall-bladder acting as a safety-valve in this condition and in pancreatitis.

Friedemann reports a mortality of 14.2 per cent for cholecystectomy, and 2.4 per cent for cholecystostomy, excluding common-duct cases. From these figures he comes to a natural conclusion in favor of the cholecystostomy.

Trendelenburg carries out removal of the diseased gall-bladder whenever possible. Kummel does not regard the preservation of the gall-bladder as the most important object to be aimed at in each case, but endeavors to avoid the unnecessary removal of a physio-

logically not unimportant organ. He removes the gall-bladder if he must; he preserves it if he can.

H. E. Hayd removes the gall-bladder in acute cholecystitis with gangrene, chronic cholecystitis, hydrops, cancer, and gunshot.

Jones Kirkland believes it a useless gall-bladder if diseased, and he treats it as one would a diseased appendix.

A. B. Johnson removes a shrunken gall-bladder with obliteration of cystic duct.

Moynihan removes the gall-bladder when grains of stone adhere to or are imbedded in the gall-bladder wall.

MacLaren removes the gall-bladder if it is functionless, when there is no indication of pancreatitis or when the cystic duct is permanently obstructed.

CANCER AND GALL-STONES

Convoiseer reports 72 cases of gall-stones in 84 cases of primary carcinoma of the gall-bladder. Musser found gall-stones in 69 of 100 cases of primary cancer, and he says that carcinoma is frequently found. Osler says 5 per cent of all gall-stone cases show cancer.

J. P. Chandler reports in the insane that gall-stones were present in 80 to 90 per cent of all cases dying from primary carcinoma of the gall-bladder.

J. A. McGlinn reports gall-stones present in 8 of 11 cases of primary cancer of gall-bladder.

From these statistics it is seen that cancer is the sequel in quite a per cent of cases, and no doubt the presence of gall-stones and infection are exciting causes. There is sufficient evidence now to prove that such is the case. Necessarily, it follows that we should operate upon the gall-bladder when there is presented strong evidences of disease or the presence of stones.

PANCREATITIS AND GALL-STONES

In the close association of the common bile-duct and the pancreatic duct there is such an arrangement, which is responsible for many cases of pancreatic disease.

Deaver reported 65 per cent of gall-stone disease associated with pancreatic disease.

Mayo reports 81 per cent of gall-stones associated with pancreatitis, and Mayo Robson 60 per cent.

Opie found that in 90 cases the two ducts had an anastomotic connection. There are three points at which lodgment of the stone may occur. The first is at the point where the common duct plunges into the head of the pancreas. The second the marked constriction where the duct penetrates the wall of the intestine, and the last is the narrow outlet of the papilla of Vater. While admitting the existence of pancreatitis, probably of ascending origin, it is, nevertheless, true that the majority of inflammations of this organ owe their existence to cholecystitis and cholelithiasis which has later affected the common relationship of the pancreatic and bile ducts. The head of the pancreas is usually affected, and in few exceptions of chronic cases it may extend to other portions of the gland.

Diabetes is occasionally associated with this condition. To recapitulate briefly:

"Chronic pancreatitis may be suspected of having complicated gall-stone disease when symptoms point to severe recurrent disease of the choledochus with marked emaciation and disturbance of the carbohydrates metabolism or evidence of insufficient action of the pancreatic ferments on the food in the intestines."

This liability of the pancreas to involvement in gall-stone disease is a strong argument for early operation in biliary infections or cholelithiasis.

It has been demonstrated that where pancreatitis exists, the preservation of the gall-bladder is imperative and that, through thorough drainage, we can effect a cure, if at all, by saving the gall-bladder for that purpose.

CONCLUSIONS

1. Gall-stones are not normal residents of the gall-bladder.

2. They are the product of infection from the alimentary canal and a late complication of the microbic invasion of the gall-bladder.

3. Many of the severe gastro-intestinal symptoms are due to the presence of gall-stones lodged in the biliary tract.

4. Cholecystitis resulting in production of gall-stones will recover less rapidly when stones are present.

5. Whenever stones can be diagnosed, an operation should be advised.

6. Gall-stones often migrate from the gall-bladder to the cystic or common duct and later lodge there, causing destruction of the tissue and obstruction of the duct. The operative mortality is 3 per cent when in the gall-bladder, and 11 per cent when in the common duct.

7. Inasmuch as an operation for gall-stones is usually one of "terminal events," an operation should be performed, if possible, before they are formed, viz., in the cholecystitis period.

8. The interdependence of the gall-bladder, stomach, liver, and pancreas is such that the gall-bladder should be preserved in all cases where it is not hopelessly diseased and unable to regain its function.

9. The frequency with which pancreatitis is associated with gall-stones in the common duct, makes the

gall-bladder an essential organ to assist in the drainage of the biliary passages in pancreatitis, and should be saved.

10. The percentage of cancer associated with and following the irritation of gall-stones in the biliary tract, should urge all practitioners to recognize their responsibility in a case of postponed operation for gall-stones.

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FOR DISCUSSION SEE PAGE 56

FURTHER ADVANCES IN THE THERAPEUTIC USE OF THE BILE-TRACTS

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Three years have elapsed since I had the honor of submitting to the Surgical Section of the American Medical Association the results of personal experiences in utilizing, therapeutically, biliary tracts opened for coincident disease. If I again venture to submit a communciation on the same subject to this Association it is because, with the lapse of time and further experience, my conviction has been strengthened that a more general knowledge of it and its more frequent utilization by my surgical colleagues is desirable.

Two very instructive papers by Rudolph Matas have recently appeared in which he cites his personal experiences with this method of access to the duodenum and upper bowel; he submits the histories of four cases, which certainly appear to have been saved thereby; and, better still, adds a very decided improvement to the technic first proposed by the writer.

For those of you who may have had no opportunity to hear or read any of these papers I may be pardoned if I briefly recapitulate what I then proposed.

In practically every operation for bile-tract disease, the operator establishes a temporary biliary fistula, either in the gall-bladder or the common duct, for the purpose of relieving the cholemia, the cholangeitis, or the cholecystitis by continuous drainage (in much the same way as a urinary cystitis is relieved). While flushing such fistulæ for the purpose of lavage of the

gall-bladder it was noted that the irrigating fluid frequently failed to return. This suggested the idea of utilizing these fistulæ for the purposes of rapid hydration, of systemic medication, of feeding, and of stimulation. The results were so startling and so gratifying that I felt justified in asking others to try it. With the refinements in technic proposed by Dr. Matas, which I describe below, the procedure recommended was as follows: If to a tube draining the gall-bladder in an ordinary case of cholecystostomy, we connect the tube of an irrigator containing, for example, sterile warm normal salt solution, the rate of flow being graduated so as not to exceed five or six drops per second, and the pressure to be no more than 20 inches elevation, a continuous flow into the duodenum can be established and maintained without discomfort to the patient. At that time I had refrained from using the irrigation through the tubes introduced for drainage of the common duct until the second or third day, i. e., till well walled off from the general abdominal cavity (for fear of leakage). Here is where Matas has shown us an improved technic, as well as how safe and efficient is the introduction at the time of operation of a small rubber catheter (a demeure) into the duodenum by way of the common duct letting it project there one-third to one-half its length. Through this, with absolute confidence of its arriving safely within the duodenum, he could introduce any desired amount of any given fluid, food, or medicament indicated. In fact, he has in this manner, and for a period of three weeks, given diuretin, panopepton, strychnia, and castor oil, Carlsbad, and Hunyadi in purgative doses to the great satisfaction of the patient, and with no untoward results because of its method of introduction.

The case-histories submitted by him are most convincing of the efficacy of this route in saving life in

some of those conditions for which it was first proposed, and to which I now desire briefly to refer.

In chronic obstructive jaundice we frequently meet an associated nephritis, probably incident to the toxic effects of the cholemia. *In just such* cases, especially after an ether anesthesia (which, by the way, should here be discarded for nitrous oxid gas and oxygen) there is imminent danger of a complete anuria. Under these conditions I have found it possible to start up promptly an active renal secretion, fill the blood-vessels, slow the pulse, quench the thirst, induce active perspiration, and wash out tissues surcharged with the bile-pigments. Matas, who calls attention to the recent clinical and experimental contribution of Clairmont and von Haberer on "Anurie nach Gallenstein Operation," has had the same experience.

But it is not my aim at this time to simply repeat the experience then recorded, but to invite your attention to some further developments which have grown from its wider use. Through the use of normal salt solution it has been observed by Dr. Wm. J. Mayo, myself, and others that the vomiting often following gall-stone operations can be ameliorated and even checked, the regurgitation into the stomach soon becoming salty to the taste, free of bile, and finally retained.

Dr. Matas calls attention to the rapid restoration of normal intestinal peristalsis, the expulsion of gas, and early bowel-movement. During the necessary loss of bile, incident to the drainage of the bile-tracts, much of the normal alkaline bodies of the intestinal tract are lost. There early appears in the reports of the patient an hyperacidity of the stomach. I have come therefore to add, when instilling the fluids into the duodenum, a few grains of sodium bicarbonate, in order to make them more nearly approach the reaction of the bile. It is true, this could be given by the mouth, but

interference with stomach acidity interferes with stomach digestion, while increase of duodenal alkalinity improves intestinal digestion and restores the biliary secretions more nearly to that form for which the operative interference has been had. This corresponds to the gratifying use by Matas of Vichy Celestin, instead of the normal salt solution first recommended. Let me here emphasize the fact that *I do not* resort to bile-tract medication in cases following a normal convalescence.

During the past winter I presented to our medical society two young men who had been for years sufferers with extensive tuberculosis of the large intestine, sigmoid, and rectum, which had resisted all the recognized methods of treatment at the hands of our best internists, as well as such benefits usually ensuing through change of environment to Colorado, to Texas and to the Swiss Alps. These cases have been cured, symptomatically, at least, by the parallel procedure, appendicostomy, using appropriate lavage with such non-toxic intestinal antiseptics as copper sulphate and quinine bisulphate. Both have been restored to apparent good health from bed-ridden and dependent conditions; both are at work, earning their living; and both are increasing in weight. One at commencement was a pitiable object of 24 years, weighing only 89 pounds, with extensive tuberculosis of the pelvic fascia, coccyx, anal region, and all the large bowel, from the anus to midpoint of the transverse colon, as revealed by a laparotomy made for the purpose of diverting the fecal stream from the painful rectal tuberculosis. The colon was so generally involved that it was impossible to find any portion of it fitted for an anus preternaturalis; hence an appendicostomy was done, with immediate, prompt, and steady improvement until now he is again at work and weighs 132 pounds. (Operation was done at the first clinical congress.) The

second case, not so extensive, but of several years' duration, rose from 154 to 180 pounds and has resumed his occupation, the painful and frequent stools having been reduced to one or two per diem.

These cases are here referred to because of the conviction that similar results in the small-intestine tuberculosis could at least occasionally be obtained, were the bile-tracts utilized as the route of access for treatment. I am fully aware that this will appear at first a severe surgical procedure to propose, but, as a matter of fact, I believe most of you will agree with me that the fastening of a drain in the gall-bladder is but little more difficult or dangerous than the anchoring and catheterizing of the appendix. Again, considering the hopelessness of all former methods, justification for such surgical interference should be found, especially in the light of the case just cited. The writer does not fail to appreciate the added difficulties and different factors entering into the problem of small-intestine tuberculosis. Here both the digestive processes and absorption areas are involved, requiring something more than the mere lavage and medication found so efficient in the large gut. Nevertheless, by a proper selection of time in relation to intestinal digestion, and medicament to suit the alkaline secretion in this location, I believe similar results could be obtained to those above described.

Since it has now been shown by Matas that a feasible and safe route for the introduction of fluids of any kind into the duodenum has been demonstrated, I desire also to offer the suggestion that we have here a safer substitute for the jejunostomy now being utilized for affections of the stomach not amenable to other surgical or medical procedures. For example, stomach ulcers that resist treatment and yet are not to be benefited by gastro-enterostomy (for we have learned by sad experience that drainage of the stomach often

fails to cure ulcers in a stomach of normal motility), might be more safely put at rest by the procedure proposed than by a jejunostomy, which is always attended by the dangers associated with fistulæ in the upper bowel, where the digestive juices are so active. I have made such use for temporary feeding in an inoperable stomach carcinomatosis. Finally, whenever such a biliary fistula is no longer needed the simple removal of the tube ensures a prompt closure.

In conclusion I desire to urge upon the Fellows of the Western Surgical Association to investigate for themselves, when the opportunity offers, some of the claims that have here been made, and not to dismiss the subject with the false impression that the writer of the paper has been carried by his enthusiasm beyond the bounds of sane surgery, in a procedure which he fully recognizes has very narrow limitations.

DISCUSSION OF THE TWO PRECEDING PAPERS

Dr. Van Buren Knott (Sioux City, Iowa): I do not know that I can say very much in discussing the paper of Dr. Benjamin. I would like to take up one subject that was dealt with in his paper, and that is with reference to the frequency of pancreatitis which we find while operating for supposed diseases of the gall-bladder. It seems to me it is impossible to determine the proportion of pancreatitis cases. I do not believe in the majority of instances, assuming there is a mild degree of pancreatitis, we can tell whether or not the pancreas is diseased; at least, in my own work I have not been able to satisfy myself that we had a condition of chronic pancreatitis until it had progressed so far that in many instances it could have been diagnosed before operation as being associated with cholecystitis. Therefore I regard the statistics of the percentage of pancreatitis cases as complicating gall-stones to be unreliable. It is a condition with our present ability we are not able, at all times, to determine.

I have been much interested in Dr. McArthur's work on the gall-bladder, having heard and read his former papers with much interest, and I have been following out some of his suggestions which seem to be of benefit, that is, utilizing the

gall-bladder or common duct as a means of furnishing fluids and nutriment to the patient. The suggestion of Dr. Matas opens up another field. The most valuable part of the suggestion made by Dr. McArthur is that it will afford a route for access other than a jejunostomy. Those who have made a jejunostomy or enterostomy high in the small intestine have seen the pitiable condition of the patient left by the discharges of the bowel running over the skin, producing a dermatitis and extreme discomfort, and a condition difficult to prevent by any means. It seems to me the opening of the common duct and the introduction of a small catheter into the duodenum is a much less serious and less fatal procedure than enterostomy. Not the least valuable part of this procedure of Dr. McArthur's is the introduction of fluids which furnish the patient with nutrition. In some of the operations that have been done for diseases of the gall-bladder we have found that the patient has been unable to take food by the stomach, and in cases of this sort rectal feeding, after a short time, becomes very unsatisfactory. All of you have doubtless had cases of this sort, and I am quite sure that life has been saved by introducing nutrition in this way. This is a comparatively new idea. Operation for the utilization of this means of introducing fluid for nourishment has not been worked out, but it has great possibilities.

I consider Dr. McArthur's closing remarks to be altogether too conservative, and I believe that the more this procedure is utilized the greater the field of application for it.

Dr. Arthur T. Mann (Minneapolis): There is one phase of this question of gall-stones which, it seems to me, is up to us from now on. It is the early diagnosis of gall-stones and the clear demarcation of the period of their formation. The diagnosis we make now is not a diagnosis of gall-stones: it is a diagnosis of the complications and of the pathological changes which accompany gall-stones. The characteristic pain, the nausea and vomiting, the jaundice when it comes—all of these are symptoms which usually come on months, and sometimes years, after the formation of gall-stones. The local tenderness and the tumor of the gall-bladder are also late manifestations, when they occur.

I think we must deliberately turn our attention toward an early diagnosis in gall-stones, just as we have done in the case of appendicitis. Twenty years ago the diagnosis of appendicitis was not made unless there was an abscess, a perforation, a gangrenous appendix, or a peritonitis. The analogy

holds true today in regard to gall-stones. We must take a step forward and make the diagnosis at the time gall-stones are forming.

The symptoms of the formation and early presence of gall-stones are very obscure. We must work them out as we did the symptoms for appendicitis. The symptoms are not directed toward the gall-bladder: they are reflex symptoms directed toward the stomach. In other words, they are stomach symptoms. In almost any case of gall-stones you operate on, if you go back into the early history deliberately you will elicit a history of periods of indigestion which come from no known cause and which do not seem to have any regular sequence of appearance, as do those of ulcer, of hyperchlorhydria, or of chronic catarrhal gastritis, but they are irregular in their manifestation, irregular in the time of their occurrence, and irregular in the time of their disappearance. They will return again from no known cause, and these irregular symptoms are practically confined to the stomach.

The laboratory findings in the stomach-contents throw out gastric ulcer, hyperchlorhydria, and chronic catarrhal gastritis; in short, the findings are practically normal. The key to the situation lies in the fact that the process from which these reflex symptoms come, is going on in the gall-bladder and lies outside of the stomach itself.

Dr. Harry P. Ritchie (St. Paul): I would like to ask Dr. McArthur, in his closing remarks, to state how long he has carried out such treatment, and how long he thinks it is justifiable to maintain a catheter in the bile duct?

Dr. McArthur (closing the discussion): Answering the question of Dr. Ritchie, I will say that Dr. Matas has exceeded me in the length of time of keeping the catheter in the bile duct. I have in cases in which I have placed the tube in the common duct, directed the tube toward the duodenum, instead of toward the liver, as has been the custom in the past. Then through that tube which extends down toward the duodenum, but not into it, I passed the ureteral catheter into the duodenum, catheterizing when necessary, not leaving it. The suggestion of Dr. Matas is a good one, and still better because the lumen of the average common duct in the adult is one-fourth inch in diameter, according to Cunningham; as large as a goose quill, according to Gray. If you put a small catheter, say number five, through the duct into the duodenum, which has been operated on for common duct

stone, the usual condition in a dilated common duct, the bile will flow around the tube into the duodenum just as before, yet your catheter really is a catheter *a demeure* in the duodenum, not interfering with the flow of bile, but making it possible to introduce anything you desire into the duodenum, at other times having it corked.

SOME PHASES IN THE SURGICAL TREATMENT OF GASTRIC ULCER

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One of the principal phases in the surgical treatment of gastric ulcer is the adoption of some plan which will effectively relieve the distress of the patient, free him from the handicap of ulcer symptoms in his wage-earning capacity, and diminish his chances of becoming a subject of cancer of the stomach.

In 1881 Wolfer devised and successfully performed an operation for the relief of pyloric insufficiency induced by the presence of a prepyloric ulcer. Since that time Mickulicz, Moynihan, Mayo, Finney, and others have rounded out the technic of a number of operations which deal directly with some phase of gastric and duodenal ulcer. In passing through the formative period these operations were frequently performed in the absence of well-grounded reasons, indeed gastrojejunostomy, or some other type of drainage-operation, has been regarded by many as a panacea for all sorts of gastric disturbances, ranging from infantile colic to ulcer hemorrhages.

It is to this misconception of the application of the principles of these operations that much unmerited reproach and abuse have been heaped upon stomach-surgery, and chagrin and miscarriage have not infrequently confronted the conscientious though misguided surgeon in his endeavors to relieve ulcer symptoms.

In a paper read before the Surgical Section of the Ohio State Medical Association in 1904 I discussed

the Rodman operation for removal of the ulcer-bearing area as being ideal in the surgical treatment of gastric ulcer, but a prohibitive mortality caused me to abandon the operation for the more simple procedure gastrojejunostomy.

Experience has shown that for one hundred times the stomach cries "Wolf"! "Wolf", the lupine is present in but few instances. Cholecystitis, ileus, septic peritonitis, appendiceal inflammations, disease of the pancreas, and numerous other pathological lesions within and without the abdominal cavity have presented the flamboyant symptoms of gastric ulcer, and a certain degree of temporary relief has followed in some of the cases submitted to operations upon the stomach, fortunately, without further bad results other than loss of time and means on the part of the patient and keen disappointment on the part of the surgeon.

While it has been definitely shown that mechanical lesions of the stomach yield readily to mechanical means in their treatment, this only serves to accentuate the supreme importance of assurance that the symptoms present are dependent upon ulcer.

The classical symptoms of gastric ulcer,—pain, vomiting, and blood, when present,—serve to establish the diagnosis to-day, as in the past, with this difference, each symptom is more carefully scrutinized and the process of reasoning by induction has gradually forced a more rigid process of exclusion in formulating an opinion.

The laboratory method for securing stomach secretions for quantitative analysis is manifestly unfair. The ordinary test-meal is an artificial procedure from beginning to end, and deductions based upon this source of information are of uncertain value and are, not infrequently, at variance with the real conditions found at operation.

The influence of the mind has been shown by Pawlow to be the chief factor in the production of stomach secretions. He demonstrated this fact by making numerous fistulæ in the gastro-intestinal tract after short-circuiting the food by discission of the esophagus. On feeding the animal, an abundance of gastric juice was formed although no food entered the stomach. He further demonstrated that division or clamping of the vagi totally arrested the formation of gastric juice.

Among the many plain every-day facts annotated on by this astute observer, one recites that dogs rendered angry before feeding will retain the food in an undigested state for a long time. On this basis he formulated the axiom that acid opens the pylorus and acid closes the pylorus.

These few citations are introduced to confirm the growing tendency upon the part of the surgeon to believe that a true concept of the chemical constituents of the gastric juice in a given case may be obtained only by examination of the stomach-contents taken at a time when the patient is in a relatively natural state of mind, the time of feeding, and the character and amount of food being considered also.

As experience broadens, we are occasionally confronted with the recurrence of ulcer symptoms after a well-performed drainage-operation in cases presenting all of the clinical manifestations of faulty drainage prior to operation and in which an active pathological lesion was demonstrated at the time of operation.

The post-operative history of such cases differs in no way from the usual happy result obtained in the well-selected case of gastric ulcer during the stay in the hospital. The patient expresses himself as feeling well, relishes his food, and suffers no discomfort after eating; and he increases in weight for a month or

two, at which time he has a recurrence of some of his former symptoms. The mild symptoms are soon replaced by more severe symptoms, and, in a short space of time, the patient, thoroughly discouraged, returns for further advice.

In a limited experience with the recurrence of symptoms after operation for gastric ulcer, I am wholly unable to distinguish at the time of operation the type of ulcer which will be cured and remain cured by a gastrojejunostomy from the type to which this operation will afford only brief relief from ulcer symptoms.

Post-operative peptic ulcer occurring in the region of the stoma has no place in the present consideration. We are here speaking of the ulcer found at the time of operation,—the raw surface which persists despite operation and the temporary abatement of symptoms.

In one instance in which ulcer symptoms returned a short time after operation, we found at the second operation a deep perforating ulcer which involved the deeper muscular fibres of the stomach-wall. The ulcer was located in the pyloric antrum and was seemingly on the eve of perforating. The stoma made six months previously was ample, and there were no perigastric adhesions at the time of the second operation. The distress of the patient, however, was greater than before the first operation. Complete relief was obtained in this case by encircling the ulcer with a purse-string suture, pushing a blunt instrument through the crater, and covering the site with a double row of seromuscular sutures.

There was little, if any, change in the physical appearance of this ulcer save at its very crater, which appeared to be on the verge of giving way. The plastic exudate observed at the time of the first operation appeared whiter at the time of the second operation, but there had been no increase in the amount. From

a mechanical standpoint the gastrojejunostomy had been a success in this case, but from a curative standpoint it had been an abject failure.

The subsequent course of this case practically excludes malignant degeneration as a causative factor in the failure of this ulcer to heal. Three years have passed since the last operation, and the patient is in excellent physical condition.

The frequency with which carcinoma of the stomach is preceded by ulcer offers a ready explanation for the non-healing of some ulcer cases, but I am convinced, from personal experience and conversation with other surgeons, that some other explanation must be sought for a certain number of failures.

The "precancerous stage" is at present occupying a rather prominent position in the scheme of surgical diagnosis.

Hendly maintains that invasion of other tissues through the blood- and lymph-streams is preceded by an insidious pathological process which renders the tissues vulnerable to the slowly growing cancer-cells. Tissues become the site of malignant change which, in the absence of this insidious process, might have held in leash the further progress of cell-invasion; that is to say, normally resistant tissue is invulnerable to cancer-cell invasion. He calls the process "permeation," and says that it is operative regardless of the direction of the flow of the blood- and lymph-streams. He does not fix a time-limit as to how long the permeation must continue ere cell-invasion becomes possible, nor does he tell us how we may recognize this insidious process, this precancerous stage of the disease. He has, however, introduced a new and highly probable hypothesis into the cancer problem, whose elucidation may render invaluable aid in the diagnosis and cure of this dread malady.

Just what proportion of the gastric ulcer cases remain unhealed after gastrojejunostomy has not been fully determined, but the fact that some of the cases persist in spite of operation, and the equally well-established fact that ulcer long subjected to the irritating influence of stomach secretions, strongly tends toward malignancy, have induced surgeons to institute more radical measures in the operative treatment of gastric ulcer.

Removal of the ulcer-bearing area (Rodman), while in many respects an ideal operation, carries a prohibitive mortality, and has not been generally accepted by the profession as the best method for dealing with gastric ulcer. Excision of the individual ulcer in conjunction with gastroduodenostomy or gastrojejunostomy is an operation which is rapidly gaining favor with American surgeons.

Excision has many commendable features; it is applicable to a solitary ulcer situated in any part of the stomach-wall. It adds very little to the risk, and the end-results are more satisfactory. Due weight should be given the physical condition of the individual case before determining upon the type of operation to be performed.

Some of these ulcer cases are much reduced in weight, and their powers of resistance are greatly enfeebled in consequence of long physical suffering, poor nourishment, and mental depression. This class of cases tax the ingenuity of the experienced in their successful management, and contribute a large percentage to the death-list in the surgical treatment of gastric ulcer.

The rapidity with which some of these half-starved ulcer cases recuperate after efficient stomach-drainage is established has enabled us to convert, in a short space of time, an almost helpless risk into a compara-

tively safe risk for a secondary or causal operation, excision of the individual ulcer or resection of the ulcer-bearing area. I have elsewhere called attention to the interrelationship of the functions of the stomach, duodenum, gall-bladder, and pancreas. The intimacy of this relationship becomes more manifest when one of this group of organs becomes the seat of a pathological lesion.

Rarely indeed have I seen a case of chronic gastric ulcer which did not show some degree of gall-bladder or pancreatic involvement. With a view to relieving this phase of gastric-ulcer pathology, Dr. S. H. Smith and myself, have, for the past two and a half years, been draining the gall-bladder in connection with the work on the stomach.

The immediate results have been very gratifying, and the after-history of those cases which we have been able to trace shows permanency of the benefits derived from this additional procedure, such as to warrant further continuance of this practice.

DISCUSSION

Dr. James F. Percy (Galesburg, Ill.): I regret that I did not receive a copy of this paper before it was read. Dr. Haines sent me the headings, and in these headings there was no suggestion of one very important point that he has made in reading his paper, and that is the nervous element in cases of stomach surgery.

In the first place, this paper, as do practically all papers today on gastric surgery, gives one the impression that all questions on surgery of the stomach are not yet settled. The essayist talked about drainage operations in stomach surgery, and we know that recent work has shown that none of these operations are drainage operations in the ordinary sense. In other words, we merely switch the pylorus, but it is not a drainage operation. You may relieve the so-called pyloric area from irritation and in that way produce benefit. But back of all this is the great question of what causes gastric ulcer, and that is the thing, I repeat, upon which none of our papers, none of our recent literature, gives us any light. I

think there is hardly any question but that the suggestion the essayist makes, namely, that the gall-bladder is back of a lot of these infections, is true. Other men have told us the appendix is the cause of these lesions, but we are not absolutely sure. I suppose one of the saddest chapters in surgery, if it were written, but it never will be written, is the gastric symptoms which lead so often to so-called surgery of the stomach.

A few years ago Willy Meyer, of New York, boldly advocated operating on these neurotics with stomach symptoms, saying that they could be cured through the mental impression made as a result of the operation. In the same volume of the *Annals of Surgery* where I saw Dr. Meyer's article, was one by Brewer, discussing the same subject from an entirely different viewpoint. While Willy Meyer advocated operating on these patients and telling them that something had been found, at the end of his paper he reports two or three cases which came back to him, as the essayist has suggested they will do, without relief, when he very naively makes the remark that, because they were neurasthenics, we should expect that sort of result. Brewer, on the other hand, reports five cases—I am speaking now from memory—in which he very frankly states that these were instances of errors in diagnosis, and that the patients had fooled themselves and had fooled him; and he regretted very much that he had not worked out the neurotic element before submitting them to any operative procedure. We have all been doing gastroenterostomies on this type of cases.

It seems to me the suggestions contained in Dr. Haines' paper will lead us to really and honestly question every stomach case as to whether the symptoms have a neurotic basis or not.

Dr. Van Buren Knott (Sioux City, Iowa): So long as this paper deals with the surgical treatment of gastric ulcer, I shall assume that it does not consider the treatment of gastric neuroses. We have trouble enough in the treatment of gastric ulcer without taking up the forms of gastric neuroses, and troubles which not only bother the patient but bother the surgeon more.

The paper and the discussion suggest this one point, and that is, the present treatment of ulcer of the stomach is not entirely satisfactory either to the patient or to the surgeon.

A few years ago we were taught that the main indication

in the treatment of gastric ulcer was to re-establish gastric drainage, and that, if the stomach was properly drained by a gastro-enterostomy made at the lowest point of the stomach, this drainage being more or less perfect, the bad symptoms of distress incident to the ulcer would disappear. We know this to be fallacious, and that drainage of the stomach at the lowest point does not necessarily relieve the condition of ulcer.

It has been said that gastrojejunostomy made proximal to the pylorus or ulcerated area would relieve the ulcerated area from the irritation incident to the efforts of the stomach to carry on its part of digestion. That is untrue. In a given gastro-enterostomy the food will go to the pyloric end of the stomach, and the ulcer be irritated through the forward or backward peristaltic waves, and so it does not accomplish what we thought it would in removing from the diseased area the irritation.

The treatment of ulcer of the stomach must be based on more logical grounds in the future than it has been in the past. An ulcer of the stomach should be treated as a diseased area anywhere else, and that is by removal, if possible. I do not like the Rodman operation, or the radical operation for the excision of a single ulcer. A single ulcer within the stomach, where accessible, can be excised. The excision of an ulcer of the stomach is usually not by any means a difficult operation. In fact, it is frequently an easy operation. It is easy to suture the stomach itself to one of the hollow viscera. No one is afraid that he cannot place sutures in the gastric wall which will not leak and be followed by trouble. In a great many portions of the stomach-wall it is a simple matter to raise the ulcerated area, and to pull on it to a sufficient degree to clamp it off with a rubber-coated clamp. There is no hemorrhage. It is not difficult to do this, and it is not serious, and it is a safer procedure than the Rodman operation. Of course, a case might arise in which the so-called Rodman operation of excision of the ulcer-bearing area is necessary, where the ulcers are multiple and where the entire pyloric end of the stomach and duodenum are involved. In a case like that the ulcer may be malignant, and operation may be indicated from that standpoint. In twenty-five per cent of the cases of cancer of the stomach the cancer-cells have implanted themselves on the ulcer-bearing area, which should be excised, and if this is done in every single ulcer, we shall do away with the necessity of gastro-enterostomy.

It is unnecessary to excise the ulcer when it is the only ulcer and do a gastro-enterostomy. The diseased area has been removed, the gastric drainage is complete, and we know that when a gastro-enterostomy is made with a more or less patent pylorus, we are apt to have trouble following. Excision of the ulcer is simpler than gastro-enterostomy. One viscus is opened instead of two; the danger of leakage is less; the time of the operation is less; and consequently the mortality is less. There is nothing to contra-indicate excision of the ulcer.

There are many things that might be said in discussing this paper. It opens up a large subject, but the principal thing I want to say is that, up to date, our treatment of gastric ulcer has not been satisfactory, and it is because that treatment has not been rational.

Dr. Haines called attention to an important point, and most of us have been making mistakes. We have been too well contented, and because someone else has made gastro-enterostomy we have assumed in these cases that because ulcer was present it was necessary to do a gastro-enterostomy. These cases do not come back to us, but they go to other surgeons, and until the treatment is placed on a rational basis and the ulcer is removed, whenever possible, by excision of the entire ulcer-bearing area, as recommended by Rodman, we shall continue to have trouble following operations for the treatment of ulcer of the stomach.

Dr. L. L. McArthur (Chicago): In the paper just read by me I called attention to a condition of the stomach in which, possibly, the use of the biliary tract for feeding might be employed, and that condition of the stomach is one which all of us should know about. Some of us have learned the lesson that we can have an ulcer of the stomach with good stomach motility. The internists have, in the last four or five years, led us to disconnect some of the gastro-enterostomies that have been done for stomach ulcer, although the diagnosis was correct and the treatment apparently the recognized treatment, but the results were not successful, and for what reason? For the reason that the motility of the stomach was perfect, or nearly so. When that is the case the gastric ulcer is not benefited by making a gastro-enterostomy. When a gastro-enterostomy is made in the stomach in which the motility is normal, the food goes out through the pylorus, and many observers, notably Dr. William J. Mayo, have found

that the gastro-enterostomy closes or becomes so narrow that it has no function as long as the pylorus is good and efficient and the motility of the stomach is good. Therefore, before all operative interferences for gastric ulcer are undertaken, we should definitely determine the acidity of the stomach and its capacity for the Ewald test-meal and the motor-meal, and if the motility of the stomach is normal, operative interference of that type by gastro-enterostomy will not be efficient.

Dr. Haines (closing the discussion): One of the chief objects of my paper was to drive home the argument that the test-meal, as we use it today, is an artificial process, pure and simple. In other words, the influence of the mind upon the secretion of the stomach is just the same as it is upon the secretion of the kidney, the mammary gland, or any other glandular tissue in the body.

Another point I wished to drive home was that for a hundred times the stomach has cried, "Wolf! Wolf!" the lupine was present once. In other words, you must seek the real cause of the symptoms. We have been operating upon the stomach when we should have been looking at the right tube, the appendix, the right kidney, the duodenum, the gall-bladder, and sometimes we should have been looking above the patient's ears. We must demonstrate a lesion in the stomach before we proclaim that it is a gastric ulcer. After establishing that fact, what shall we do? I must dissent slightly from the first speaker who discussed the paper and who said that gastrojejunostomy is a drainage operation. Cannon and Black have pointed out that bismuth paste will drain back into the stomach from the gut through the stomach into the stomach likewise. As soon as you relieve the irritation it will drain the natural way, and there will be nothing passing through the stomach. If the operation does not relieve the pathological lesion of ulcer for which it was instituted, what shall we do? You must do one of two things. The eye-men taught us many years ago that a corneal ulcer which perforated would heal, and so adopting that measure I put an instrument through the crater of an ulcer which failed to heal after gastrojejunostomy. The case is well. Excision is a far better operation, and I fully agree with Dr. McArthur that he has a most valuable method in feeding and draining through the gall-bladder. I think much of the pathological condition that finds expression in stomach symptoms is really outside of the stomach. There is a close inter-relationship between the stomach duodenum

and the pancreas and gall-bladder disease, in that one necessarily has an influence on the other, and until you find out which one of the group is diseased and relieve the pathological condition, the symptoms will continue.

A REPORT OF TWO CASES OF TUBERCULOSIS, SOLITARY AND APPARENTLY PRIMARY, OF THE FALLOPIAN TUBES

ALBERTIUS J. BURGE, M. D.

IOWA CITY, IOWA

In offering this report at this time, I was prompted by two definite reasons. First, it has long been a question of interest to me why the reproductive system in the female should stand as relatively immune, or be so regarded, to the primary ravages of a disease, which, in the homologous system of the male, seems to present rather a favorite field for a particularly vicious, persistent, and ofttimes fatal, type of such involvement. Second, the apparent rarity—I say *apparent* rarity—with which such does in reality occur, at least in our region, which is contributory to the State University of Iowa, which I believe offers a particularly fair average of conditions for observation, of which I will speak later. This rarity would seem proven by the reply of one surgeon of wide experience whom I questioned as to his meeting primary tubal tuberculosis in his practice of many years. He said, shortly, that "he did not believe that such occurred at all, strictly speaking." Again, by the observation of Prof. Albert, our pathologist, when I sent in my specimen this fall, that out of some six or seven hundred specimens of Fallopian tubes submitted

to him, this was the first case of tuberculosis of the tubes as a single and isolated involvement. Within the past week I have had a second case, equally definite, and I present the specimens of each, with sections and the pathological report, for your consideration.

Therefore, I wish to occupy the valuable time of this Association, as briefly as possible, with the hope of presenting something of interest, but especially for the personal satisfaction of hearing somewhat of the experience of this widely distributed body of observers representing so great a portion of our country.

In reviewing the subject, to some extent, in available literature, the observations and statistics are much varied and somewhat indefinite, owing, I infer, to a differing viewpoint, many considering it only with general salpingitis or else as a form of general or disseminated peritoneal or pelvic tuberculosis; others, again with widely varying degrees of exactness in diagnosis, varying from clinical evidence only, to gross specimen examination, and a few of exact histological methods.

Martin, of Berlin, collecting 620 cases of tumors and inflammatory growths of the adnexa, found but 17 cases, or 3 per cent, showing tubal tuberculosis. Von Rosthorn, of Prag, in 103 cases, found 5 per cent. Menge, of Leipsic, in 70 cases, found 10 per cent. Williams, of Baltimore, in 91 cases, found 8 per cent. Junge, reporting from Greifswald clinics, estimated 25 per cent. Kronig, in a report based upon his own and other collected experiences, estimates that an average of 10 per cent of all adnexal involvements will show tuberculosis as an etiological factor, and Simmonds estimates that of all female post-mortems in general 1.2 per cent show such involvement.

This, however, hardly covers the exact phase I wish to consider,—that of the possible *primary* involvement

of the Fallopian tubes by tuberculosis as a disease entity. I use the term *primary* advisedly, not in the sense of direct inoculation through the genital tract, which probably does not occur at all in numbers to be considered, nor again through the free peritoneal opening of the tube, and so secondary to peritoneal invasions, but in the sense that we distinguish hematogenous invasions of the epididymis of the male carried by the blood-stream, from either inhalation or intestinal portals, here making their first pathological manifestation.

I find one very definite and helpful report by Bondy, of Breslau, in the Wiener klinische Wochenschrift of July 6, 1911, giving the results of two years of study in this direct line, of the material gathered from 1909 to 1911 from the clinical material of Rosthorn in Vienna and Sellheim in Tubingen. In Vienna, a hotbed of general tuberculosis, he was able to collect but 10 cases, and in Tubingen 20 cases, making 30 cases in the two years. Here we note a factor which we find alluded to by the more general observers quoted above, namely, that tuberculous tubal invasion is markedly more relatively frequent in the agricultural or village areas. The explanation suggested is the great overweighing of infective specific salpingitis and septic puerperal infections of the large city. If such holds true, then, as suggested above, Iowa perhaps presents an average, if not a rather favored, field for such occurrence, especially considering the frequency as well of general tuberculosis with us.

Bondy's reports and diagnoses were the results of careful histological sectioning of all submitted cases of tubal involvement, and the tubercular processes ranged in severity from definite tubercle formation down to slight but chronic catarrhal affection of the tubal mucosa, where in some cases the etiological factor was demonstrable only by animal inoculation.

He concludes that Kronig's estimate of 10 per cent is not far wrong, in the prevalence of tuberculosis as the primary etiological factor in adnexal processes.

The two cases I wish to present show an interesting variation in class, while both were from good farm-homes and of clean personal and family history; one was a girl of 19 years near the beginning of reproductive life, and one a mother, now 45, and at the end of the climacteric.

Case 1.—Miss I. H., female, aged 19, brought by her family physician, Dr. F. L. Darrow, of Columbus Junction, Iowa, with a history and diagnosis of apparent chronic appendicitis, covering a period of some fourteen months previous. She carried at times of observation a temperature from 98° to 102°; was very sensitive in the lower right quadrant, where a low-lying appendix seemed to stand out very plainly on palpation. Attacks more frequent and severe at menstrual periods, which occurred irregularly from three to five weeks apart, with a regular but scanty flow of one to two days. Her trouble, however, was not at all confined to the menstrual epochs and in many ways seemed to justify the diagnosis named. Owing to the sensitiveness of the patient, I did not make a vaginal examination until under the anesthetic, and after it I planned to expose both tubes as well.

Briefly, the laparotomy disclosed no evident involvement of the appendix, which lay retrocecally, while the appendix-like mass, palpated abdominally, proved to be a rigid, distended, nodular Fallopian tube projecting off in line with McBurney's point. In the fresh specimen it was about the size of a finger, unmistakably nodular and tubercular on inspection. The left tube was likewise affected, but was lying crumpled down toward the cul-de-sac. A careful inspection of surrounding viscera failed to show any evidence whatever of other involvement, or peritonitis, or traces of

adhesions, nor did a general examination reveal any kindred glandular or pulmonary infection. This would seem still further verified by the accompanying chart, which shows a good recovery, and after the twelfth day a disappearance of the suggestive afternoon rise in temperature, noticeable in this and her previous illnesses. Observation for two weeks, carried out through the kindness of her home physician, three months after operation, shows an absence of temperature, with a report of improved general health and a gain of twelve pounds in weight. Therefore, from every evidence, I feel that this was strictly a case of primary and isolated involvement of the Fallopian tubes. Their complete removal has removed her only infection.

I wish to diverge here for a moment to say that had this case been of less pronounced type or indefinite, as in some of the cases Bondy found, I fully feel that the involvement would have been overlooked, or at least not removed, as I now feel I have done in cases in the past, in a class of which this girl is a type, and to which I wish to refer later.

Case 2.—Mrs. M. Z., female, aged 45 years, farmer's wife, of Bohemian parentage, but American reared. Mother of three children, the youngest 10 years of age. One year ago she began having much pelvic distress at times, some irregular hemorrhage per os uteri, attributed at that time to the irregular and disappearing menses of the climacteric. During the past few weeks hemorrhages have returned, and during the past week have been very profuse at times. She was brought to the hospital by her attendant, Dr. J. R. Gardner, of Lisbon, Iowa, who regarded the condition as one of malignancy. Digital examination revealed a uterus about twice the normal size, adnexa apparently adherent, and very sensitive. This, with an elongated, lacerated, fissured cervix and the history

of increasing hemorrhage, made a hysterectomy seem the only advisable course to pursue, and after three days of rest and preparation the same was done, on December 11th, and the specimen I have here with section to present. In this case the tubes were greatly distended, at the time representing a length of three or more inches, with an inch or more diameter, and filled with a puriform, muddy, cellular fluid resembling the tubercular debris of broken-down lymph-glands, and the wall so fragile that one ruptured in the even, careful handling of removal. I again felt that we had to do with a tuberculous invasion, to all appearances primary, and confined to the tubes. The case, I am glad to say, is now promising a good recovery.

The sections in each case show well-marked tubercles in the partially destroyed or degenerated mucous and muscular walls, with distinct giant-cell formation.

If one may be allowed to generalize from two cases only, it seems to me they may represent two interesting classes of cases. The older woman, with tubes distended quite to the point of rupture, carrying a temperature from 99° to 101°, stands in daily danger of such intra-abdominal rupture and a quickly disseminated peritoneal tuberculosis, as well as by the slower spread by contiguity, or by lymphatic absorption. The young girl may represent a quite different but equally important surgical class. Especially so in the stages where the process has not developed to this definite and unmistakable form clearly indicating operation, but, remaining in that chronic catarrhal or less clear type, may they not account for a certain number of unsatisfactory cases, which, I imagine, we all have now and then?

These are usually young women, single, or, if married, without children, sufferers of a more or less chronic type, coming for operation, with an innocent,

or, at most, indefinite sexual history, but with chronic pelvic or right-sided abdominal trouble, leading a life of semi-invalidism, and, too often, for want of another diagnosis, their trouble is labeled chronic appendicitis or adhesions. But on exploring the abdomen we find an innocuous appendix, and perhaps a pair of murky, flabby, cyanotic-appearing tubes, far from vigorous or healthful in appearance, yet too good to sacrifice. The appendix is removed, a few adhesions broken up, and the patient returns home, unbenefited, to continue in her old condition, or often to gradually grow worse, and we hear later she has developed peritoneal tuberculosis, or succumbed to a systemic invasion of the same.

I venture an humble prediction that the future will recognize distinctly a tendency of the female adnexa to develop primary tuberculosis, as does the epididymis of the male. If so, what shall be the treatment accorded such? Will it be the same vigorous, radical, and summary course which the analogous disease in the male merits and now receives? In view of the added dangers of an intraperitoneal location in the female, I venture to say that it will, saving the ovaries where free and safe, but in no wise temporizing with the tuberculosis-infected tube.

DISCUSSION

Dr. John B. Murphy (Chicago): I have been very much interested in this paper from several standpoints. First, from the pathological findings; second, from the clinical history; third, from the association of this lesion with hemorrhages from the uterus; and, fourth, from its surgical treatment.

The reason for the deposit of tubercle bacilli in the tube is not definitely settled. Whether it is of hematogenous origin in the tube or of hematogenous origin in the vas deferens or epididymis, which is the common point of location in the male organs of generation, is a question.

Some years ago I wrote an article on tuberculosis or lesions of both of these tissues. It was my belief that the infection

in the tube was more commonly through the peritoneum or through the uterus, and that tuberculosis of the uterus is a more common lesion than is generally believed. In both of the doctor's cases he shows the evidences of mixed infection and not a pure infection. In a pure infection of the tube the fimbriated end is always open; it is the only type of infection of the tube that retains the patency of the tube during the inflammatory process; in all other types of infection the tendency is for the tube to close by agglutination to the neighboring structures. Where the tube remains open, the clinical course of the case is almost identical with that of recurrent appendicitis. The patient will have a period of relief, in fact, of good health, then will have a sudden attack of pain, nausea and vomiting, local sensitiveness, elevation of temperature, and often a discernible effusion in the peritoneal cavity. Examination through the vagina or through the rectum usually shows a thickening of Douglas' pouch in the class of cases of the type I have mentioned. Once the tube becomes closed in the type of case the doctor has reported, it does not give the recurrent appendicitis syndrome of symptoms as does the open fimbriated end.

Perforation of the tube on the side of tuberculosis, as mentioned in the doctor's paper, is not uncommon. When it does occur, it gives a limited peritonitis, usually rapidly circumscribes itself, and repairs itself. The peritoneum has such colossal resistance against tuberculosis, more than any other tissue in the body, that it rapidly heals, or encapsulates the debris of tuberculosis that is thrown out by the open end. I have seen these cases with a plug of cheesy debris at the end of the tube. We have observed it in all phases of repair and destruction from infective and inflammatory processes. The lesion, from a curable standpoint, requires the same treatment that a similar lesion of the testicle itself does, namely: removal of the tube at as early a stage in the disease as possible; the same is true with regard to removal of the epididymis. Primary infection of the testicle proper never occurs. Primary infection of the epididymis from some focus in the lymphatic system or elsewhere does occur.

In the treatment of these cases the removal of the tube, with the encapsulation of the end, suffices for the cure of the local condition; not only that, but the extensive peritonitis that has resulted from the repeated attacks of leakage from the end of the tube entirely repairs. I had occasion to see one of these cases some eight months after operation. I operated

for hernia later in the same patient, and although the peritonitis was extensive at the time of the primary operation, every vestige of peritonitis had disappeared, with nothing to indicate there had been peritonitis in that particular case.

I want to speak particularly of one thing in connection with the clinical course of these cases, and that is the hemorrhages that occur in young girls past fourteen, or who are from fourteen to twenty-three or twenty-four years of age. These hemorrhages usually occur with menstruation, rarely ever between the menstrual periods, and in that relationship tuberculosis of the genitalia resembles a hemorrhage from fibroids of the uterus. I am referring now particularly to girls who have menstruated two or three days, seven or ten days, twelve or twenty days, or who flow continuously from one period into another. I have had a dozen or more of this class of cases in the last few years; but there is no evidence of tuberculosis tuberculin test gives a positive reaction for tuberculosis. I that one is able to make out from the physical signs. The have found in all of these cases, except one, that by putting them on tuberculin treatment, especially in those cases where we got a positive tuberculin response, the hemorrhage has ceased without any operative procedure, and it has saved me the trouble of operating on them. A great many surgeons have curetted, and scraped, and rubbed, and have done everything but a hysterectomy in these cases, and the results were not satisfactory. The use of tuberculin has saved me from operative procedures in this class of cases, and has led to permanent results, with enormous improvement in the general condition of the patients.

Dr. Burge (closing the discussion): I wish to thank Dr. Murphy for his remarks. I have enjoyed them very much.

FIBROUS TUBERCULOSIS OF THE PERITONEUM INVOLVING OMENTUM, INTESTINES AND UTERUS

C. Lester Hall, M. D.

KANSAS CITY, MISSOURI

Mrs. Bessie L. entered the Post-Graduate Hospital with the statement that she had been operated upon at the Bell Memorial Hospital of the University of Kansas, and that the surgeons had been unable to remove all the cysts. She gave a very indefinite history, and all active symptoms had subsided. Her general condition was good, but apparently there were extensive adhesions in the lower abdominal and pelvic cavities, and to relieve this the operation was done on December 6, 1910. She was dismissed from the hospital on December 26, 1910. All the contents of the abdomen had adhered together in growths resembling cartilage involving the omentum, uterus, and bowels.

For the early history of the case I am indebted to Dr. Don Carlos Guffey, who had charge of the case at the Bell Memorial Hospital on March 31, 1910, which is as follows:

Mrs. Bessie L., age 23, married, housework, Norwegian.

HISTORY.

Chief complaint.—Pain in right side of pelvis; menorrhagia and metrorrhagia.

Present illness.—Began about one month ago with pain in the right side of the pelvis and profuse uterine hemorrhage. The pain usually was dull, but sometimes sharp. In December was the last regular period, which continued scantily for ten days. Since then flow has been almost constant. The blood is very dark and frequently comes in large clots.

Previous illnesses.—Measles in childhood, which settled in eyes, leaving patient near-sighted. At twelve years of age she had intermittent fever. Four years ago the patient had an attack of inflammation of tubes and ovaries. One year later (three years ago) a curettage was done for the control of an irregular hemorrhage, which had lasted five weeks. The patient had been nauseated and vomiting for three months previously.

Family history.—The mother is well and 52 years old. The father died at 39 of paralysis (?), four brothers and three sisters are living and well. One sister died from accidental poisoning. Paternal grandfather died of old age; the other three are living. One maternal uncle died of dropsy and an aunt of consumption.

Menstrual history.—Menses began at 7. Patient was so frightened that she washed her clothing in a branch, the menses being suppressed thereby for three months. Thereafter it was regular until a miscarriage two years ago, since which time it has frequently appeared twice monthly, lasting seven to ten days with a free flow. There has been much intermenstrual pain. The last regular period, which was in December, was very scanty.

Child-bearing record.—One miscarriage two years ago at five and one-half months, cause unknown. She was given an anesthetic and the fetus was removed manually. She was in bed for six weeks with fever all the time. In September or October, 1909, the patient, believing herself pregnant, consulted Dr. Moses, who found an enlargement to the right of the womb.

Leucorrhea.—A premenstrual leucorrhea exists. This began four years ago when she had the attack of pelvic inflammation. It was white, thick, and non-irritating, but profuse, requiring a napkin. Now it is not so profuse.

Pain.—Is usually sharp. Frequently she has felt like fainting, which has been associated with hemorrhage and nausea.

PHYSICAL EXAMINATION.

General.—Temperature 98.6°; pulse, 98; respiration, 24. The *skin* is smooth and nonpigmented, but of a dusky, muddy hue (hardly a cachexia). Eyes: The left pupil is large and irregular in shape. The reactions are normal, except the left is imperfect. There is a slight prominence of the eyeballs. Ears: Hearing is defective, the patient being unable to hear a watch with the left and at only two inches with

the right ear. Mouth: The teeth and throat are negative. There is a slight enlargement of the thyroid and a very slight tremor in the outspread fingers. The thenar eminence of the left hand is atrophied.

Digestive system.—Negative.

Urinary system.—Negative. Urinalysis: Acid; 1024; clear; no albumin; no sugar; amorphous urates and mucous threads; a few crystals of calcium oxalate.

Abdominal examination.—Tenderness low down on right side. Tumor palpable immediately about Poupart's ligament of the right side, apparently extending down into the pelvis.

Vaginal examination.—Uterus: Cervix slightly softened and enlarged; the lower uterine segment hard; the fundus enlarged, hard, and to the left. To the right and in front, especially, is a soft, yielding, tender mass, the size of an orange. Apparently it is immovable and attached to the uterus.

Operation.—A laparotomy revealed a large, hard, grayish mass in the right side of the pelvis, with button-like masses in the ometum, covering the intestines, right broad ligament, and right pelvic wall. The condition being inoperable several of the masses were removed for microscopical examination and the abdomen closed in the usual way.

Microscopical examination.—Carcinoma of the ovary with metastiatic nodules.

Note.—On April 13, 1910, the patient left the hospital. The abdominal incision healed by primary union.

Further investigation into the case convinces me that the title of my paper, as printed in the program, should be changed to read as I have it above.

Three prominent forms of tuberculosis of the peritonueum are miliary tuberculosis, chronic diffuse tuberculosis (cheesy tubers), and chronic fibroid tuberculosis, which is a terminal stage of the preceding varieties. Kelley says, contrary to expectations, recognizable tuberculosis of other organs in connection with pelvic tuberculosis is not common, not even in the lungs. In fact, the presence of tubercular peritonitis of the pelvic organs seems often to offer immunity to tuberculosis elsewhere. The avenue of infection is

often difficult or impossible to determine. It might occur at any age, but most frequently in middle age. Heredity often furnishes a cause, but in the history of the present case only one member of her family, an aunt, died of tuberculosis. It may have come from an infected lymphatic gland in remote parts of the body, carried in the circulation to the pelvic organs. It may have followed the marital relation. A surprising condition is found in such cases, in that, notwithstanding the extensive matting together of the intestines, the peristaltic function of the bowels is not interfered with, and we do not have the trouble often found with a single adhesion of the bowels.

An interesting feature in the case was the unusual size of these nodules, varying from that of a mustard seed to that of a small hazel-nut, which were not simply implanted on the tissues, but were buried down in the omentum and mesentery, making it impossible to remove them without tearing into the bowels. As stated, all evidence of acute inflammation had subsided. Dr. Guffey, having seen the patient some time before, it is highly probable important changes had taken place and active symptoms had subsided at the time I operated.

Recovery from the operation was uneventful, and today, twelve months after the operation, the patient reports herself in fair health and physical condition.

REPORT OF THE PATHOLOGIST

In tuberculous infection of the alimentary tract, the lymph-adenoid apparatus, tonsils and intestinal lymph-glands, form the most frequent avenues of infection. The bacteria, either free or engulfed in cells, undertake to pass the lymph-glands and gain entrance to the general system, through the blood. These little glands, here as in other infectious diseases, act as filters and become thereby themselves infected.

Tuberculous lymph-glands of the omentum and mesentery resemble somewhat the typhoid lymph-glands of the same region, with the exception that the latter are more acutely in-

volved, and either break down or recover in three weeks' time from the inception of the disease. In tuberculosis of the lymph-gland, the onset is more gradual, and, if recovery takes place it does so only after months, and sometimes years, have elapsed.

After the patient recovers from typhoid fever, the lymph-glands usually reassume their normal, healthy and physiological condition; in tuberculosis of the lymph-gland this is hardly to be expected since the prolonged infection causes the normal structure of the gland to be replaced with dense connective tissue. This transformation into fibrous connective tissue is called "fibrosis."

Early changes in the lymph-gland, following tuberculous infection, such as tissue-degeneration, inflammatory exudation, proliferation, giant-cell formation, and caseation of the cells, more centrally located; and fibrosis of the supportive structure of the node, especially its more external portions—the more centrally located portion may pass through the afore-mentioned stages and ultimately form calcareous concretions. The outer connective tissue may, when the case terminates favorably, form a very dense, compact layer, which encroaches upon and frequently replaces all the caseated area, the calcareous deposit alone remaining to mark the focus of early infection. The glands remain simply a ball of scar tissue, in which may or may not be found, calcareous concretions.

COMPLICATIONS OF DISPLACEMENTS OF THE COLON

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It is my purpose to relate a case which for me had an important lesson, and it may be of interest to some who have not fully considered the serious complications which may arise from displacements of the various divisions of the colon. I feel that it is unfortunate for me that my first appearance before this honorable body is to confess a failure where many of you would have achieved success. My apology must be that we learn more quickly and thoroughly from our failures than from our successes.

The title of this paper as printed on the program is a little misleading, and yet it was difficult to state tersely the condition I wished to discuss in more exact terms, without making the title unwieldy. I will first relate the case and then proceed with its discussion.

The diagrams accompanying the paper may not all be referred to in detail, but will serve to illustrate the main points for which I hope to secure your interest. While each one represents a condition actually found (and the authority is given), they are not selected because of great similarity to the case reported, or because of the great weight of authority of the reporter. In selecting cases I have attempted to illustrate the principal fundamental displacements, and the method by which they occur. Other cases of far more striking

and complicated abnormalities could have been secured. The case was as follows:

Personal history.—Male, aged 52, widower with two grown daughters. Merchant in good circumstances and high social standing. No bad habits, active, and energetic. In no sense an invalid, but able to attend to business regularly each day.

Previous illness.—Ordinary diseases of childhood. Twenty-one years ago had a severe and prolonged illness from an acute abdominal inflammation with diagnosis of appendicitis. Was attended by Dr. T. J. Pitner, of Jacksonville, who furnished the history of the attack from his notes made at the time. The pain and tenderness were in the right lower abdomen and were accompanied by fever, prostration, and all the evidence of an extensive infection. The abdomen was greatly distended for many days, and during this time the patient spent much of his time on the right side with the knees drawn up. The bowels were obstinately constipated, and there was much nausea and vomiting, especially in the early part of the illness. Patient was confined to his bed for about two weeks. His ultimate recovery was quite satisfactory, and he went back to his duties about the usual time. He did not again consult his physician until 1899, when he complained of "some gastric and intestinal pains," for which he had four prescriptions. He did not again seek advice until 1904, when he complained of "intestinal indigestion," accompanied by diarrhea. During 1904, 1905, and 1906 he consulted his physician several times on account of this diarrhea and of abdominal distress. The gastric or intestinal distress was attributed to indigestion and for a long time thought to be due to errors of diet. He was active in business, well nourished, and could in no way be classed as an invalid. He had the annoyance of a diarrhea and sometimes pain. During these years the diarrhea and abdominal pain were accompanied by more or less tenderness in the right iliac region.

In May, 1907, this patient was referred to me by Dr. Pitner with the above history of intermittent attacks of diarrhea accompanied by more or less pain in the right lower abdomen. Sometimes the pain was on the left side and it was always accompanied by tenderness in the right iliac fossa. Some of his symptoms suggested a colitis. On rising in the morning he would immediately have a small stool; after dressing he would have a second small stool; after eating his breakfast, a third, and after arriving at his place of business, a fourth,

etc. It was imperative that he answer these demands at once, and after four to six evacuations in the morning, he would be comfortable the rest of the day and only occasionally would he be troubled at other times. He was becoming decidedly neurasthenic. Physical examination showed marked localized tenderness and thickening on the right side, and after consultation he was advised to have the appendix removed. Nothing was done at this time, and in fact I did not see him professionally again until he was referred to me by Dr. Edward Bowe in June, 1910. In the meantime he had consulted three or four physicians of national reputation in Chicago, St. Louis, and New York. From all he got the same advice, namely, "have the appendix out." He presented himself again on July 9, 1910, and reported that, as he still had the pain on the right side and as the diarrhea was increasingly annoying, he had decided to have the operation for appendicitis.

Operation.—After the usual preparation the abdomen was opened at the external border of the right rectus. Adhesions were encountered involving the anterior abdominal peritoneum from the point of incision to the wing of the pelvis and on around to the posterior abdominal wall, and they extended as high as the lower right hypochondriac region and into the pelvis below. The viscus surrounded by adhesions was plainly large gut, but the adhesions were so extensive and dense that it was impossible to distinguish the exact portion of the colon involved, but it seemed fair to assume from its location and direction that it was the cecum and ascending colon, and that the cecum was bound down in the pelvis. (See diagram No. 3). After breaking up a considerable number of the adhesions I felt sure that I could outline the lower end of the cecum over to the brim of the pelvis, and this conclusion was emphasized by finding a loop of the ileum entering beneath the mass of adhesions in this direction. That portion of large gut from the level of the anterior superior spine of the ilium to the brim of the pelvis was narrowed to one-third its normal capacity and after passing the brim of the pelvis widened out again to what seemed to be the normal capacity of the cecum, although it was bound down in the pelvis by some adhesions which it did not seem wise to break up. The narrowing of the gut above seemed to account for the symptoms, and consequently no effort was made to seek out the appendix, which seemed to be down in the pelvis. After breaking up sufficient adhesions to release to some extent the nar-

rowed and bound down colon it seemed to have sufficient capacity and the circulation seemed ample. The abdomen was closed, and the patient returned to bed in good condition.

After forty-eight hours the patient developed symptoms of acute obstruction. and the abdomen was reopened. The first thing which attracted attention was that the colon was distened in a direction which seemed to be below the seat of constriction. This was a very confusing circumstance, as, according to our previous findings, this portion of the colon should be collapsed. It was evident that our previous findings were incorrect. In order to test the matter, a rectal tube was introduced. It came up on the right side of the pelvis into what was erroneously thought to be cecum, but now was demonstrated to be the sigmoid displaced to the extreme right and adherent in the right iliac fossa and to the anterior abdominal wall. (See diagram No. 3). By breaking up more adhesions it was evident that the ileum did not find its entrance into the cecum in the pelvis, but passed upward behind the constricted sigmoid to enter the cecum just below the border of the ribs and that it was considerably involved in the adhesions and that the lower end of the cecum and the appendix were held by broad and enveloping adhesions. Rarely are such extensive areas of adhesions found as existed in this case. The appendix was almost obliterated. After finally locating the cecum the whole condition cleared up. It was now plain that all the colon, except a small portion at the splenic flexure, was on the right side of the vertebral column, and that the splenic flexure was far from its usual location. After liberating to some extent the constricted portions of gut, the caliber seemed sufficient and the circulation good, and the abdomen was again closed. This did not relieve the symptoms, and the patient died in a few hours.

When it was too late it was evident that an anastomosis with or without resection should have been made. The postmortem fully confirmed the above findings and showed no other lesion in either abdomen or pelvis.

This case is reported with the hope that it may furnish a basis for profitable discussion and that it may serve to put us more on guard for the possibility of similar conditions. The literature of displacements, accompanied by inflammatory conditions of the colon, has been searched with some degree of care, but I have not been fortunate enough to find the record of a

similar case. No doubt some among the members of this association have met similar cases and may report them in discussion.

The case shows that more careful study of the position of the colon is necessary. "Abnormalities do not, of themselves, produce symptoms but lead to mistaken diagnosis" (von Bergmann), and operative procedures, based on a failure to understand the possible displacements of the various portions of the colon, may be disastrous. In the case reported the extensive results of the appendicitis obscured the contents of the right iliac fossa to such an extent that we were entirely misled. The first supposition on finding the gut narrowed and adherent was that we had an exaggerated cornucopia cecum. Later, finding the ileum apparently entering a portion of large bowel of comparatively normal size, led us to believe that the stricture was in the ascending colon, and that the cecum was in the pelvis. Only subsequent events demonstrated the great error of this view.

Attention is also called to the fact that the constriction and post-operative obstruction in this case was not at the point of any of the "anatomic constrictions."

It is necessary to consider a few facts from the development of the colon, in order to have a clear idea of some of the displacements. This case, and many others illustrated by the diagrams, show plainly that more than one factor enters into their production. By the end of the tenth week the intestinal tube which has been straight, has developed its U-shaped loop, and the end of the cecal bud is beginning to form the appendix. All of the colon is still to the left of the median line, but by the end of the fourth month the cecum, which was at the umbilicus, has migrated to the left hypochondrium and rotated across the duodenum and superior mesenteric artery to a position be-

neath the liver, where it remains until birth, when it descends soon after to the right iliac fossa.

The text-books make slight mention of the frequency and importance of the variations in the location of the colon, but a search of the current literature reveals reports of a considerable number of cases. Recently studies along this line have been active. It is difficult to find exact statements of the normal location of the various segments of the colon, and there is considerable conflict among authorities. (See Diagrams Nos. 1 and 2.) The cecum is not infrequently found over the brim of the pelvis (see Diagrams No. 17 and 18), or, as in the case reported, high up in the lumbar region. (See Diagrams No. 7 and 9.) The ascending colon may, on the other hand, be so long as to make secondary folds (see Diagram No. 18), and its mesentery may be (Curschman) long enough to be twisted. The transverse colon may be short at either one or both flexures (see Diagram No. 20). The ascending and descending colon may be almost like the limbs of an inverted V. Probably much more often the transverse portion may be too long, and descend in the middle like an M, with the middle point as far as the pelvis. (See Diagrams No. 21 and No. 22.) There may be a double fold of the transverse colon. It has been said that congenital anomalies of the descending colon are practically never seen (W. Wayne Babcock and Boardman Reed). If this is true the marked displacements of the descending colon shown in many of the diagrams must be considered as acquired. (See Diagrams Nos. 4, 6, 9, 12, 13, 15, 16, 17, 18, 20 and 24.) These may be cases in which the descending colon was pulled over by the displaced sigmoid. The descending colon may present folds, but an elongated sigmoid flexure which is accompanied by increased length of the large intestine, is more common. The flexure of the sigmoid may reach

to the transverse colon or to the diaphragm. (See Diagrams Nos. 14, 15, 16, etc.) Sometimes the sigmoid has several folds.

From a study of a considerable number of reported cases it would seem that the splenic and hepatic flexures of the colon are the two most uniform portions, and that it is comparatively rare for either to be seriously disturbed. The accompanying illustrations show the splenic and hepatic flexures almost uniformly in place.

There is quite as much variation in the size and length of the gut-tube and the length of the mesentery as there is in location. (Compare Diagrams Nos. 9 and 20 with Diagrams Nos. 16 and 26.) The length of the adult colon varies, within the limits of normal function, from 39 to 78 inches. (W. Wayne Babcock.) The length or character of the mesentery is probably the most important single factor in variations in the location. In 18 per cent of cases the ascending and the descending colon have a mesentery (Jounesco), but the cecum is never anchored by a mesentery but remains movable (Gainsburg). A long mesentery gives greater mobility and allows the loops to be displaced. In such cases inflammation may give rise to adhesions, which easily retain displaced loops in abnormal positions.

The conflict of opinion pertains mainly to the sigmoid segment. One writer (Deaver) says: "It will be seen, first, to cross the psoas muscle and the external iliac vessels at a right angle, then to descend vertically to the floor of the pelvis along its left. From this point it runs along the floor to near the right wall of the pelvis, turns upon itself, and passes to the left of the median line, to terminate in the rectum." Another author (Piersol) says: "It begins at the crest of the ilium as a loop of varying length, which is attached by mesentery, and ends at the middle of the

third sacral vertebra. Its usual length is from 25 to 56 cm. (10 to 18 inches), but is occasionally much longer. As the sigmoid flexure descends along the sacrum it usually curves to the right and crosses the median line." It is stated (Cunningham) that in 92 per cent of cases the pelvic sigmoid is found in the true pelvis after death. Robinson, after taking measurements in 200 cases, says: "The first and most frequent position is when the sigmoid flexure lies above the pelvis against the dorsal wall, chiefly in front of the lumbar vertebræ and to their left. Most other positions of the sigmoid are uncertain, temporary, and variable."

The difference of opinion of anatomists as to whether the sigmoid belongs normally in the pelvis or above it, and whether it joins the rectum in a direction from the left or from the right, would indicate that this loop of large intestines has a wide range of normal mobility and position, depending largely on the length of its mesentery. No author consulted considers that this mobility allows the sigmoid to occupy the position of the cecum as in the case reported. Only when one segment of the colon permanently invades the territory belonging to another segment can it be said to be abnormally located, although its location may be unusual.

The mesenteric attachment ends at about the third sacral vertebra, and this marks the termination of the sigmoid. Its length is variously estimated from 10 to 27 inches.

"The diameter of the sigmoid is less than one-half that of the cecum" (Mayo). The function of the sigmoid to act as a reservoir to contain fecal material is facilitated by the several curves.

The difference of opinion regarding the length and location of the sigmoid is probably explained by the fact that at birth it comprises nearly one-half of the

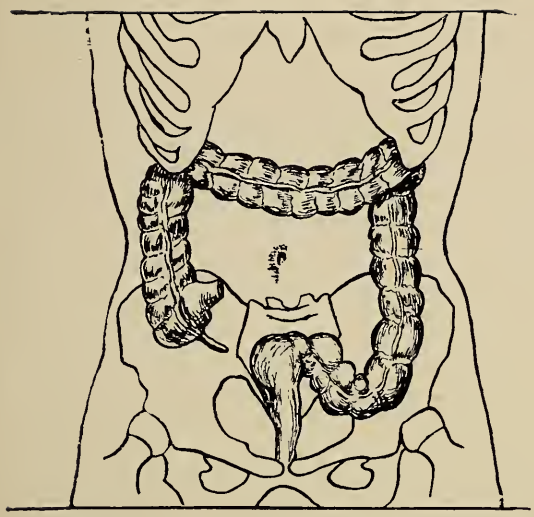

Diagram No. 1—Course of colon as usually described. Gray, Henry, "Anatomy, Descriptive and Surgical." 1905, p. 1311.

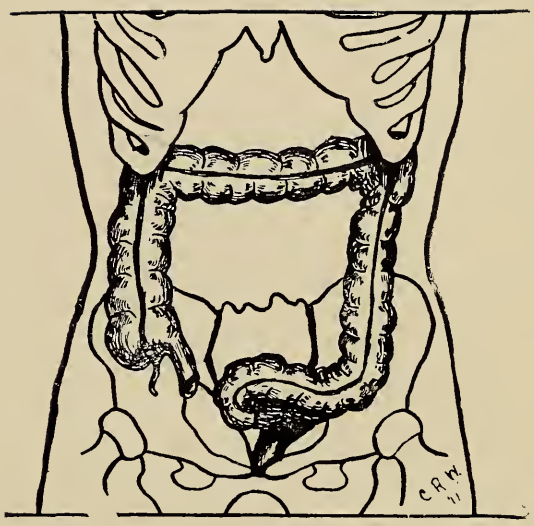

Diagram No. 2—Course of colon as frequently described. Tuttle, James P., "Diseases of Anus, Rectum and Pelvic Colon." 1902, p. 39.

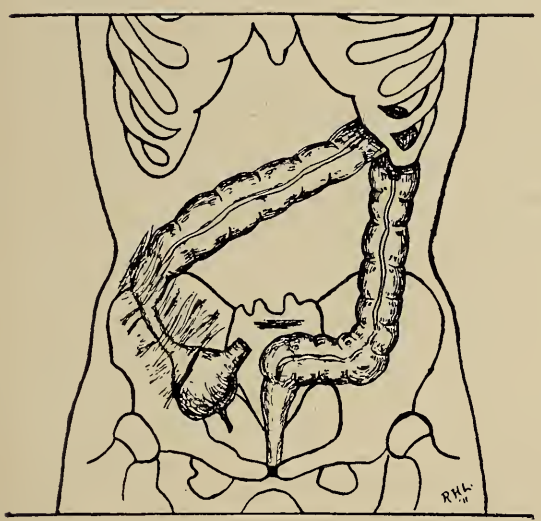

Diagram No. 3—Condition thought to be narrowing of the cecum and ascending colon, found at primary operation in author's case. History of appendicitis and large gut found constricted by adhesions.

Diagram No. 4—Condition demonstrated by secondary operation in author's case. The constricted large gut was the junction of the descending colon and sigmoid which were displaced into the right iliac fossa. The cecum was high up near liver.

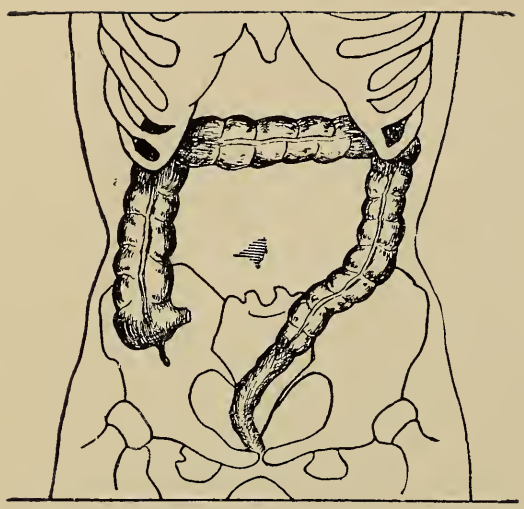

Diagram No. 5—Case where "there was shifting of rectum to right side, the sigmoid descending into the pelvis over promontory of the sacrum." W. Gruber in Arch. f. Path. Anat. etc. Berlin, 1865, V. xxxii, p. 94.

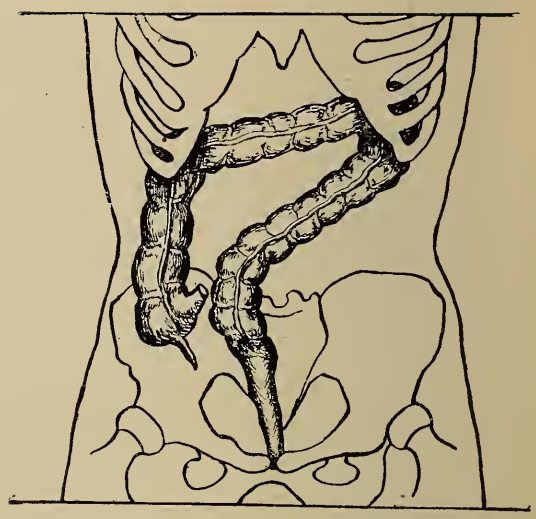

Diagram No. 6—Case where "the sigmoid flexure passed across the right iliac fossa before it entered the pelvis on the right side of the middle line." J. Chiene, Jour. Anat. and Phys.. London, 1867-9, V. ii, p. 14.

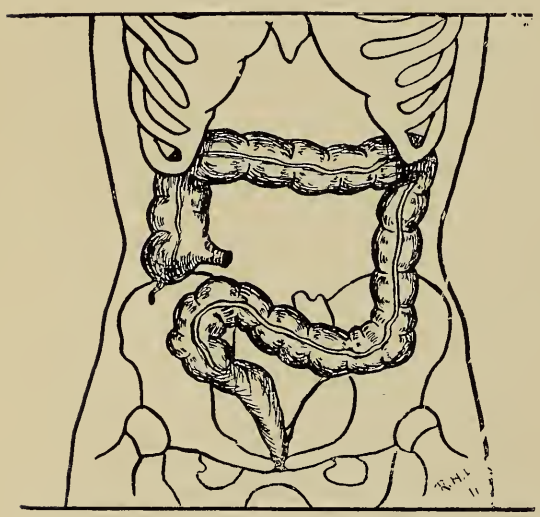

Diagram No. 7—Case of a boy 7 years old with sigmoid on right side. J. Reid, Edinburg, Med. and Surg. Jour. 1836, Vol. xlvi, p. 70.

Diagram No. 8 —"The sigmoid circled the left iliac fossa, lying close behind Poupart's ligament, then ran back along the left margin of the pelvis, across the sacrum, to the right side and then down into the pelvis." D. E. Mundell, Dominion Med. Mo., and Ont. Med. Jour. 1895, V. 39.

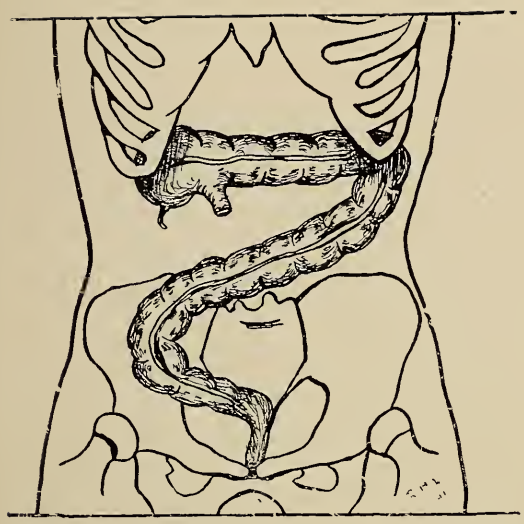

Diagram No. 9—"The cecum was found in the right hypochondriac region in close proximity to the gall-bladder, the appendix vermiformis was normal in structure and pointed downwards. The sigmoid flexure occupied the usual position of the cecum on the right side. There were no peritoneal adhesions present." A. Farenhott, Boston Med. and Surg. Jour. 1894, V. cxxxi, p. 427.

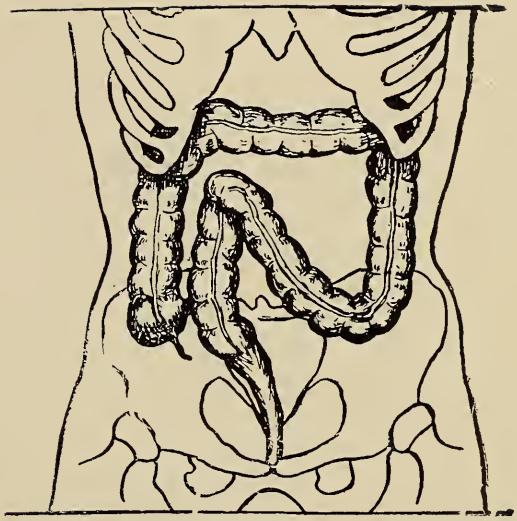

Diagram No. 10—"Fatal case of obstruction and enormous distention of belly arising from a peculiar conformation of the colon." A. Buchanan, London Med. Gaz. 1839, Vol. 11.

Diagram No. 11—"The cause of this seems to be some fetal pathological adhesion between the cecum and lower end of the omega-loop." The ileum enters cecum from the right showing arrested rotation. W. S. Melsome, Jour. Anat. and Phys. 1893, V. xxx, p. 27.

Diagram No. 12—"The usual site of the cecum was occupied by the sigmoid flexure, which, passing transversely across the body of the fourth lumbar vertebra, formed a bend in the right iliac fossa and then ran down into the pelvis on the right side. The cecum was high in the lumbar region." D. E. Mundell, Dominion Med. Mo. and Ont. Med. Jour. 1895, V. 39.

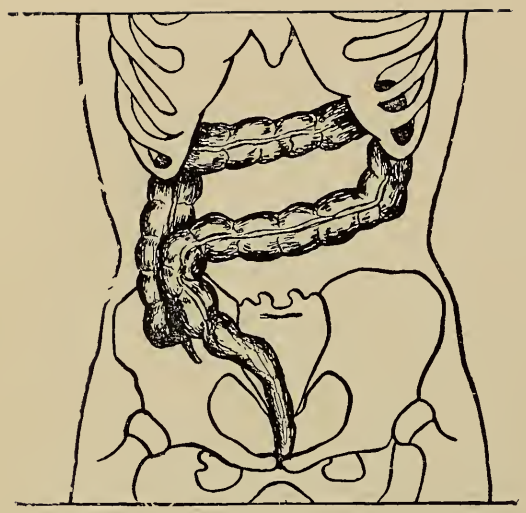

Diagram No. 13—The small intestines were in front of the colon. The author says, "This is congenital because the sigmoid and descending colon cross behind the origin of the mesentery—it differs from those cases where the sigmoid gets into the right iliac fossa because of a long mesentery." E. E. Maddox. Jour. Anat. and Phys. Lond., 1882-3, V. xvii, p. 403.

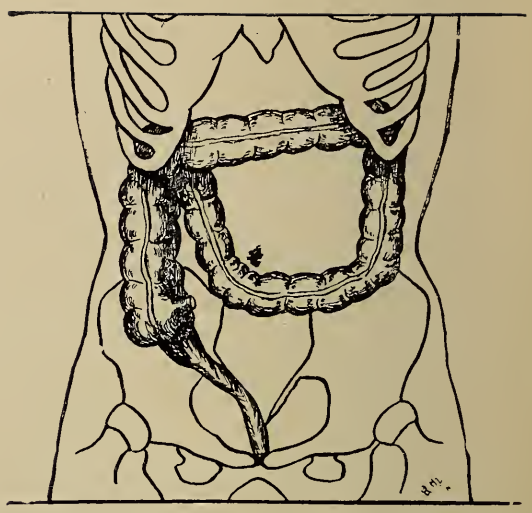

Diagram No. 14—Due to unusually long mesentery. The author says the attachments of the ascending and transverse colon "were so long that they could be drawn into any region of the abdomen." J. Barton, Trans. Royal Acad. Med. Ireland, 1889, V. vii.

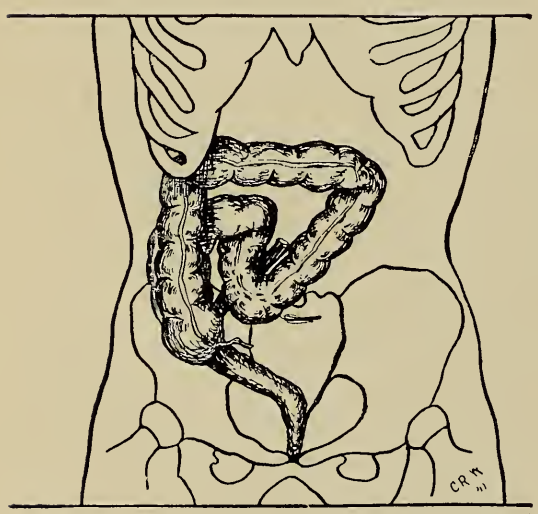

Diagram No. 15—The whole extent of the colon was placed behind the peritoneum which covered only its anterior aspect. The root of the pelvic meso-colon was in contact with the cecum. Hamdy and Fahmy, Jour. Anat. and Phys. V. xliii, p. 242.

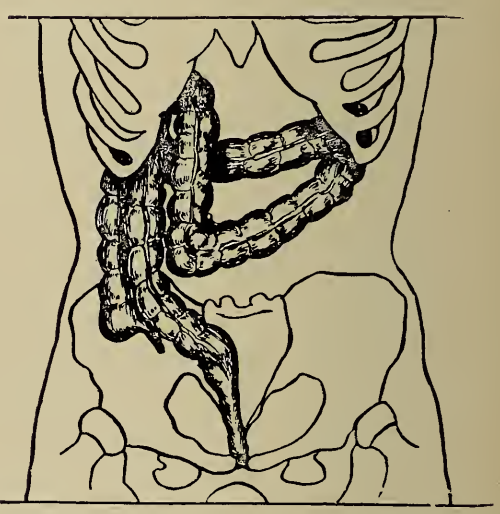

Diagram No. 16—Long loop of descending colon and sigmoid reaching as high up as right vault of diaphragm, lying between the muscle and the liver. Alec. Fraser, F. R. C. S. Prof. Anat. R. C. S. Tr. Royal Acad. Med. Ire. Dublin, 1905, V. xxii, p. 400.

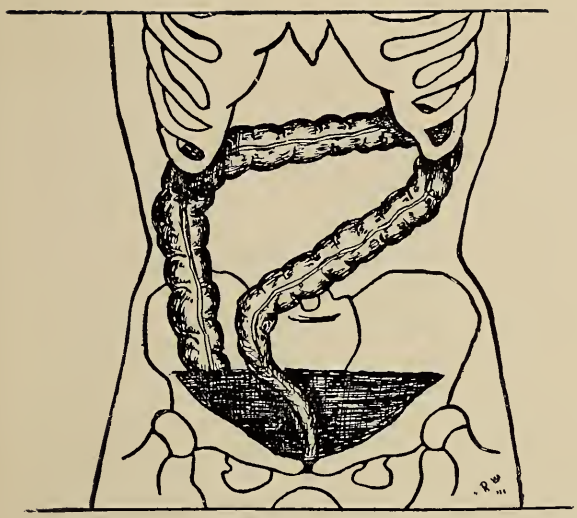

Diagram No. 17—"Case where the descending colon crossed the vertebral column obliquely and the sigmoid and rectum descended on the right side of the pelvis" and the cecum was buried behind the pelvic peritoneum. W. Gruber, Arch. f. Path. Anat. etc. Berlin, 1865, V. xxxii, p. 94.

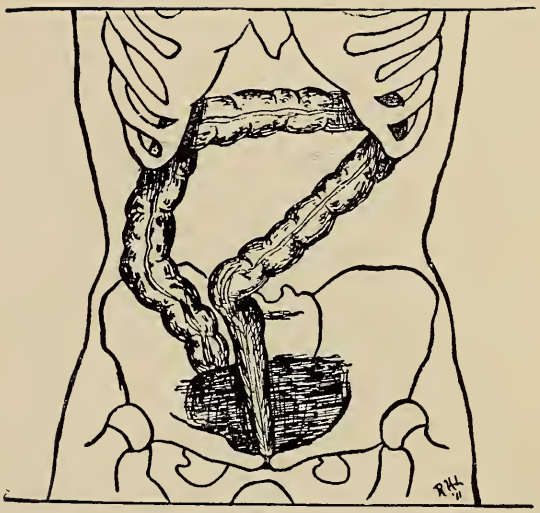

Diagram No. 18—Exploratory operation by Edward Martin. Diagnosis, appendici- "The part felt on palpation was the abnormally placed sigmoid. Cecum and appendix buried beneath the pelvic peritoneum. No attempt to remove appendix." John B. Schober, Am. J. Med. Sci. Oct., 1898, p. 405.

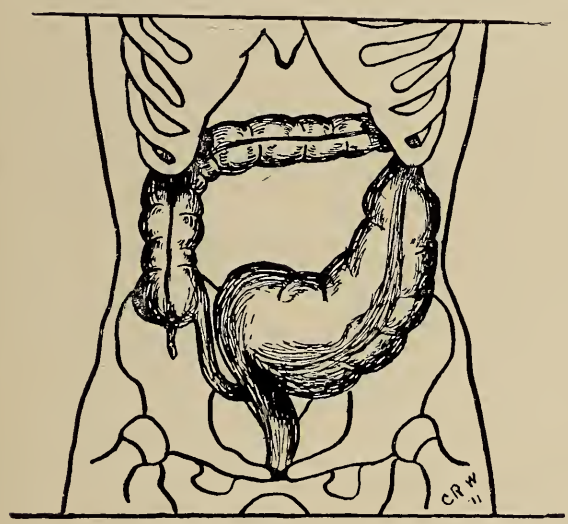

Diagram No. 19—Sigmoid and descending colon distended from obstruction. Illustrates how the adhesions may have begun in author's case (Diagram No. 4). Adapted from Kelly-Noble, p. 398.

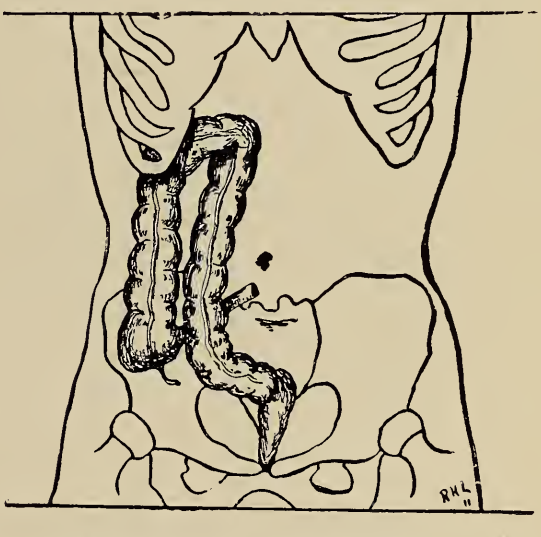

Diagram No. 20—"Transverse colon folded upon itself at level of gall-bladder; the descending colon located in the right flank parallel to the ascending colon; the sigmoid flexure was in contact with the cecum; the rectum occupied its accustomed place." M. Mascarel, Bull. de la Soc. Anat. de Paris. 1840-42, V. xiv, p. 213.

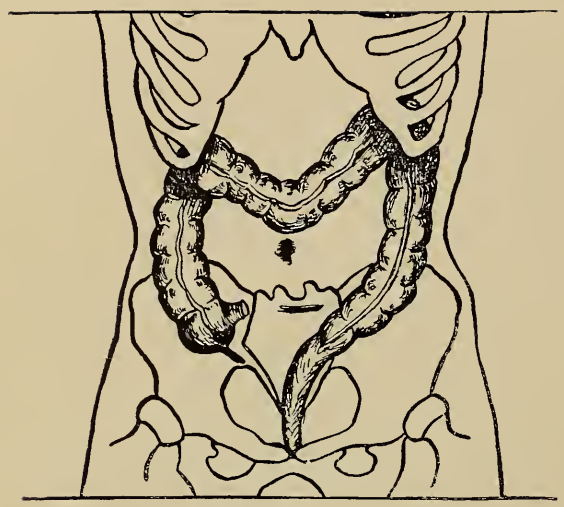

Diagram No. 21—Fig. 61 Case V. V-shaped course of the transverse colon. The appendix lies behind cecum within the layers of the meso-cecum. Boardman Reed, "Diseases of the Stomach and Intestines." 1911, p. 450.

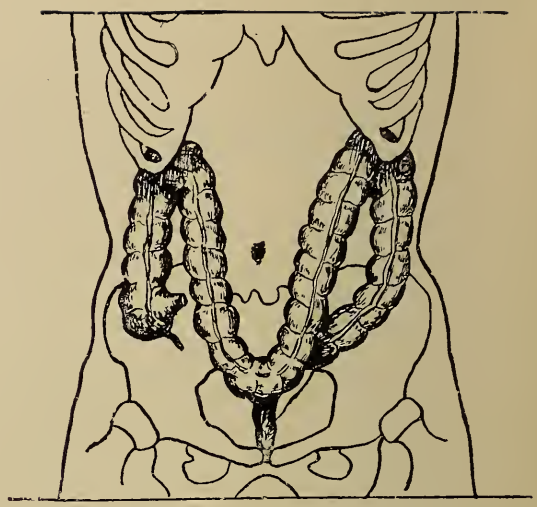

Diagram No. 22—Fig. 62, Case VI. Exaggerated V-shaped course of the transverse colon. Boardman Reed. "Diseases of the Stomach and Intestines." 1911, p. 450.

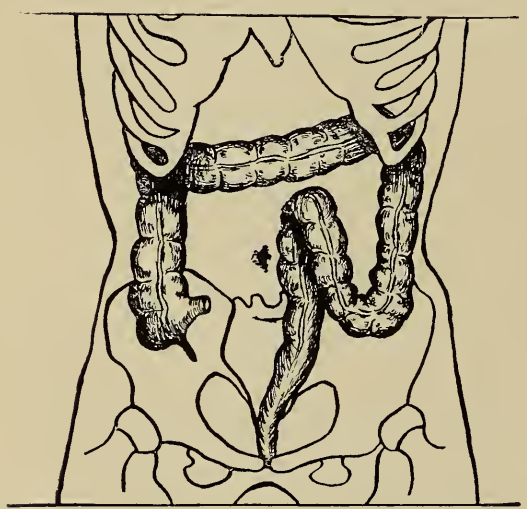

Diagram No. 23—Fig. 58, Case II. Elongation and displacement of the sigmoid flexure. Boardman Reed, "Diseases of the Stomach and Intestines." 1911, p. 447.

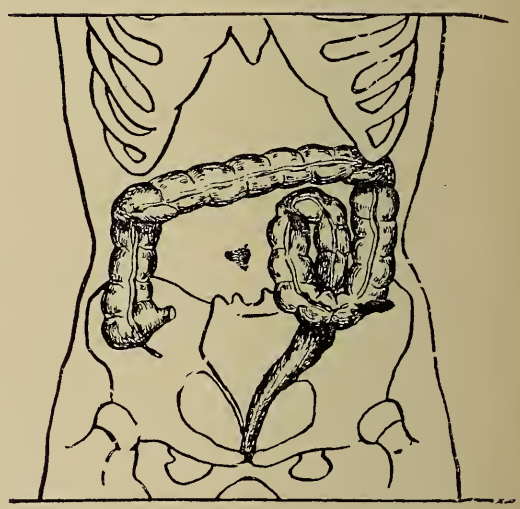

Diagram No. 24—Fig 59, Case III. The sigmoid loop touches the lower border of the left kidney. Boardman Reed, "Diseases of the Stomach and Intestines." 1911, p. 448.

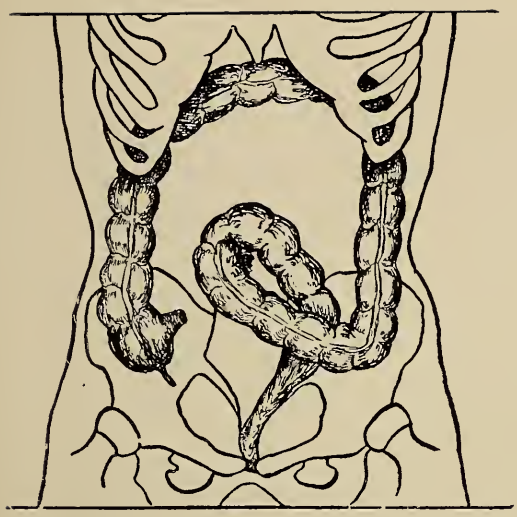

Diagram No. 25—Fig 60, Case IV. Exaggerated and displaced sigmoid loop. Boardman Reed, "Diseases of the Stomach and Intestines." 1911, p. 449.

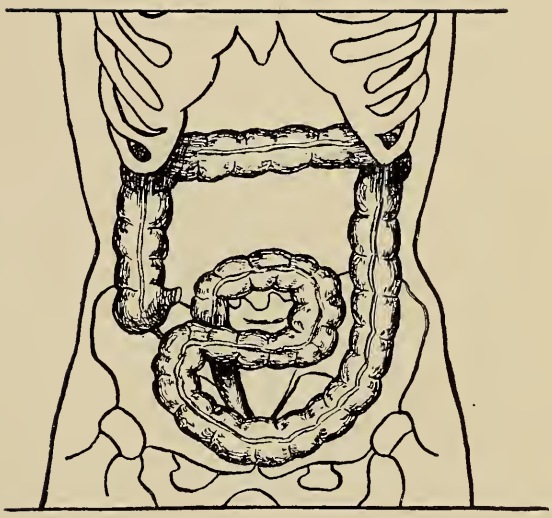

Diagram No. 26—Case of obstinate constipation. There was obstruction due to a twist where the colon terminated into the rectum and patient died with great distention. A. Buchanan, Lond. Med. Gaz. 1840, V. II, p. 99.

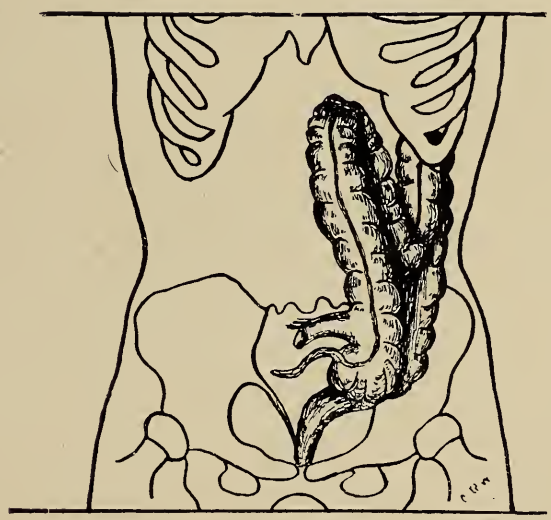

Diagram No. 27—Fig 118. Abdominal viscera of adult human female, in a case of arrested rotation of the intestines. (Columbia University Museum, Study Collection.) Geo. S. Huntington, "The Anatomy of the Human Peritoneum and Abdominal Cavity." 1903, p. 60.

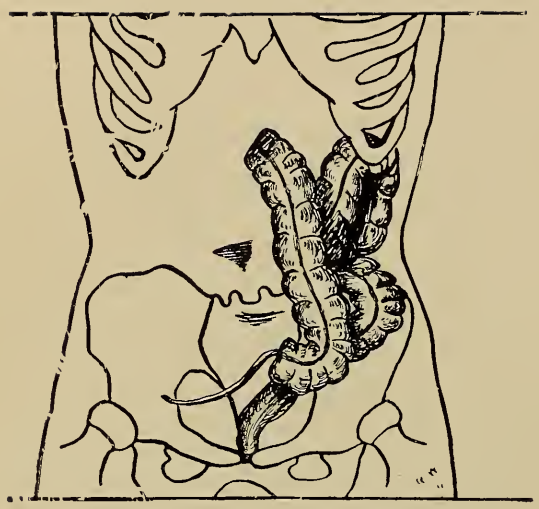

Diagram No. 28—Fig. 121. Abdominal viscera of adult human; non-rotation of intestine. (Columbia University Museum, Study Collection.) Geo. S. Huntington, "The Anatomy of the Human Peritoneum and Abdominal Cavity." 1903, p. 60.

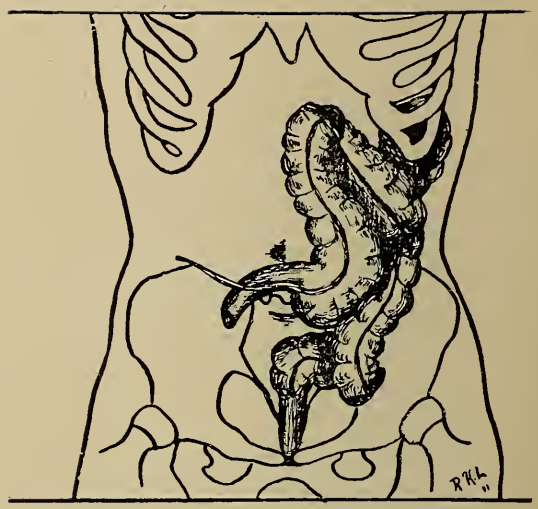

Diagram No. 29—Fig 120. Abdominal viscera of adult human male; non-rotation of intestines. (Columbia University Museum, Study Collection.) Geo. S. Huntington, "The Anatomy of the Human Peritoneum and Abdominal Cavity." 1903, p. 60.

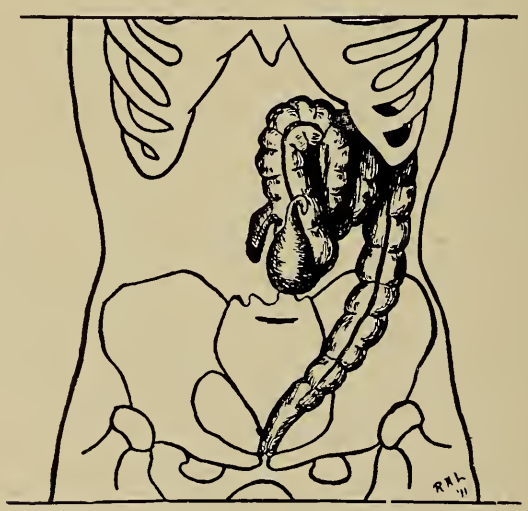

Diagram No. 30—Fig 122. Abdominal viscera of child, two years old; non-rotation of intestine. (Columbia University Museum, Study Collection.) Geo. S. Huntington, "The Anatomy of the Human Peritoneum and Abdominal Cavity." 1903, p. 60.

entire length of the large intestine. (Gainsburg.) Pierson quotes Treves as saying that the length of the intestine and especially the colon is singularly constant at birth. He found the average length of the colon to be one foot and ten inches. This length is maintained for two months, owing to the fact that the large gut grows at the expense of the sigmoid. At four months they have assumed their permanent proportions. Piersol also calls attention to the fact that, owing to the relatively small size of the infant pelvis, the sigmoid loop lies on the right side of the abdomen at that period.

It must be accepted as a fact that the colon normally has a wide range of variations in location, and, further, that few of the abnormal variations are due to a single cause, but are rather due to a combination of causes. An undescended cecum leaves room for an elongated sigmoid loop to occupy the right iliac fossa. Later, an acute inflammation fixes the sigmoid in its abnormal position and furnishes the distention which carries the descending colon up out of place, and later contractions shorten up the gut length. Such a combination of causes may explain the condition found in my case.

Attempts at classification of the displacements of the colon seem to be incomplete and unsatisfactory. Most authors rest content with describing them under two heads, namely, the congenital and acquired. A true understanding of the mechanism of displacements requires further division of these main heads and the addition of at least one other is important. For purposes of study the following classification is suggested:

I. Congenital.
   a. Arrested development.
      1. Of gut tube.
      2. Of mesentery.

b. Over development.
   1. Of gut tube.
   2. Of mesentery.

c. Arrested rotation.
   1. At the umbilicus.
   2. Splenic flexure.
   3. Hepatic flexure.

d. Non-descent of cecum.

II. Acquired.

a. Ptosis—"a falling."
   1. Over-distention.
   2. Weakened ligaments.

b. Displacement by weight of other organs.

c. Displacement by tumors.
   1. Of gut.
   2. Of other organs.

d. Inflammatory displacements.
   1. Over-distention.
   2. Traction resulting from adhesions.

e. Displacement from obstruction and over-distention.

III. Combinations of congenital and acquired causes.

Still other subdivisions may be made, as, for example, one author (von Bergman, VII, p. 252), has classified them as to location in the abdomen and proportionate length of the various segments.

It is surprising how little, comparatively, has been contributed from the operating-table regarding abnormalities in the location of the colon. This is shown by the fact that in only three of the cases illustrated, and in very few of the reports examined, was the abnormal position diagnosed during life. In most of the cases where an operation was undertaken it was for acute obstruction. We are still too much guided by postmortem findings, in which there is no way to know whether the abnormal position was of long standing

or accidental, or whether it was the product of the patient's final illness. It will require considerable work upon the part of surgeons to clear up the prevalent ideas of the position of the colon and especially the position of the sigmoid flexure; nor do we know as much as we should regarding those influences which lead to acquired abnormalities. Many of the cases reported as anomalies are really not abnormal but simply represent segments which are longer or shorter than usual, as illustrated in Diagram No. 5. Eastmond and others have demonstrated the value of the *x*-ray in showing the location of various parts of the colon.

True congenital anomalies are usually plain enough, but in most of these no harm or inconvenience comes to the patient until some acquired influence complicates the congenital abnormality. Scant emphasis has been placed on the complications which may arise from displacements of the various parts of the colon, and especially displacements of the cecum or of the sigmoid. It is upon this point that I especially wish to place emphasis and to this end I have gathered a number of cases and have made diagrams of several to illustrate some of the most frequent types of displacements. My case illustrates how a similar complication might have arisen in any one of the several cases shown if the malposition had been complicated by peritonitis with adhesions. In one case, reported by Shober, the proper treatment is still unsolved. Evidently, the patient will not be relieved until the cecum is released from its abnormal position as shown in Diagram No. 18, or removed. This patient has been ill for months with symptoms of chronic appendicitis. The ileocolic junction could not be found, but in its place had been felt on palpation an abnormally placed sigmoid. The operator's presumption was that the cecum and appendix were both be-

hind the posterior peritoneum of the pelvis but he hesitated to open up this space.

Algrave reports two cases in which the cecum and sigmoid were both in the right iliac fossa and adherent. The author says: "It is not uncommon on opening the abdomen of adults and even more of infants to find the sigmoid flexure of the cecum in contact and more or less located in the right iliac fossa, but with the exceptions noted we have always found the sigmoid mobile and independent, and the descending colon was always in its customary place." He says: "The adhesions between the cecum and descending colon appeared to be a physiological coalescence, certainly not due to any inflammatory process." According to Virchow, Simpson, and others, it would seem that such adhesions might be due to intra-uterine peritonitis. A number of observers speak of fetal peritonitis as an explanation of adhesions where there is no history of peritonitis after birth, and attribute changes of position of the colon to this cause. (Treves, Byron Robinson, Shober.) The history of peritonitis is often uncertain. I have seen two cases of ruptured appendix and abscess where the patients disclaimed any special discomfort up to the moment of rupture, and were never in bed on account of illness until they were operated on. The case reported in this paper had too many strong and constricting adhesions to be considered as belonging to that class reported by Hofmeister, Lane, Jackson and others. It had a distinct history of violent appendicitis, which would amply account for the adhesions. Several of the cases illustrated reported bands of "adhesions" which held the displaced segment of gut and many of the authors discussed the origin of these bands.

In the absence of a history of peritonitis they are frequently described as "congenital." The presence of bands of connective tissue across peritoneal sur-

faces are certainly abnormal, and whether they are described as a "physiological coalescence," a "membrane," "veil-like adhesions," "fetal adhesions," or "bands of adhesions," they must all arise from practically the same process of irritation of the serous surfaces, which leads to the formation of new connective tissue and blood-vessels, which under ordinary conditions we call peritonitis. The pathology of these various conditions is so similar in its results as to appear identical. Practically there is good authority for the belief that many bands and constrictions begin *in utero,* while others are developed so insidiously as to escape attention until the contractions and fixations produce symptoms. Fraser, in reporting the case illustrated by Diagram No. 16, says that he made careful examinations of over 1,500 abdominal cavities and that "this is the only time I have found the left lateral half of the abdominal wall clear of colon behind."

Cuibe reports a case in which the descending colon crosses the midline until it is in contact with the cecum, and was found adherent to the appendix. The sigmoid was in the right iliac fossa. This case has several points in common with my case, but diarrhea is not mentioned as a symptom, and marked constipation was not present. In fact, in no report examined is diarrhea enumerated as an important symptom, except in my own case.

Diagram No. 6 illustrates a case reported by J. Chiene in which the sigmoid "was tied down in the right iliac fossa." In many of the cases, especially the older reports, nothing is said about adhesions, but in the face of acute inflammation of the adnexa, appendix, or gall-bladder, it is easy to see how the displaced loop could become adherent. Several reports speak of peritonitis and adhesions as a cause of displacement. While the inflammatory process may not be the direct cause of the displacement, yet a loop of

colon with a long free mesentery or a loop enormously distended, as illustrated in Diagram No. 19, may easily be displaced toward an inflammatory area and become bound down by adhesions. It would seem evident from some of the cases reported that the sigmoid was displaced after the descent of the cecum from the fact that it is in front of the cecum. This is illustrated by Diagrams Nos. 13 and 16. While Diagrams Nos. 14 and 15 illustrate cases in which the cecum seemed to have descended after the sigmoid was displaced as it lay in front of the sigmoid loop. The displacement of the long sigmoid loop and the cecum is the most frequent and most easily understood. Both are usually congenital in their origin, but may be exaggerated by other conditions. Most of the displacements are combinations of the congenital and the acquired. Diagrams Nos. 7, 9, 11, and 12 illustrate cases in which the descent of the cecum is incomplete,—a congenital abnormality; and in Diagram No. 11 the ileocecal junction has not rotated to the left, but still maintains the foetal position. Some authors seem to think the descending colon is more commonly in its normal position than almost any other portion, but the cases I have examined do not bear out that assumption. Nine out of the 28 cases illustrated show the descending colon markedly out of its normal position. This is an important consideration in lumbar colotomy. My defeat was due to being too sure that we were dealing with the cecum and the ascending colon, when, in fact, we were dealing with the descending colon and the sigmoid. Mundell has called attention to the difficulty of finding the appendix where the cecum is displaced upward or downward. The presence of the appendices epiploicæ on the sigmoid and their absence on the cecum is of great importance. If the landmarks are in the least doubt the whole cavity should be searched until the position of the whole colon is under-

stood. Mascarel's case, illustrated by Diagram No. 20, is the only case found among a large number of reports in which the colon did not approach the spleen.

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DISCUSSION

Dr. Clifford U. Collins (Peoria, Ill.): Dr. Porter told us this morning of the mistake in judgment he had made, and Dr. Black has told us how we may incorrectly diagnose the conditions that are found. If we would all report the errors we have made in the past year, doubtless the literature of surgery would be very much enriched and all of us greatly benefited.

I am led to conclude from Dr. Black's paper that malpositions of the colon of themselves do not cause much trouble, and we know that adhesions of the colon do not always cause trouble. Some surgeons suture the colon to the gall-bladder to keep the stomach from adhering to the gall-bladder, as was suggested by Dr. Wyllys Andrews a few years ago, and some suture the sigmoid to the top of the broad ligaments, as in pelvic work, and there is no trouble as a result. The trouble seems to come when the malposition of the colon is associated with a pathological condition, and the operator has difficulty in interpreting the conditions found.

We are indebted to Dr. Black for the excellent paper he has given us and for putting us in a position to guard against a condition which I fear any of us may run into at any time.

Dr. James E. Moore (Minneapolis): I have noticed a number of the anomalies the essayist has mentioned. In the past year I reported two cases in the *International Clinics*, one of which I wish to relate to you. It was a most interesting experience. A woman, the wife of a doctor, came to me from a distance, with a diagnosis of tumor in the abdomen. When she arrived I could find no tumor. She ran a temperature, and I found she had pyelitis. I kept her in bed three weeks and the pyelitis cleared up. It was further found that she was pregnant three or four months. She said to me, "I have a tumor in my abdomen and I want it removed." I said to her, "My dear woman, I cannot find the tumor, and I cannot operate without finding it." The husband came, and the next morning I found a large nodular mass in the middle of the

lower abdomen. I called in assistants and they could see and feel the tumor. Another doctor was called in later, and the tumor was not there; it was a phantom tumor. I opened the abdomen the next day at the urgent request of the husband, and I found the tumor was made up of cecum, the whole ascending colon, and an unusually long mesocecum, with the appendix wound around the cecum a little distance from its base in such a way as to constrict it. There were inflammatory conditions, and fecal matter had accumulated in the cecum, forming a tumor, and the tumor would swing over to the mid-line. When the bowels were cleared out the tumor would disappear. I fastened the cecum to the right side of the abdomen with catgut sutures, and the woman passed through pregnancy without any trouble. That is one variety of phantom tumors with which we have to contend.

Dr. B. Merrill Ricketts (Cincinnati, Ohio): Concerning the irregularities of the intestinal tract, the paper illustrates very beautifully many conditions. The question is: What is an anomaly? Then, what should we do when these anomalies exist, and where should we do it? There are many anomalies which are harmless, and it is a question whether we should resort to the "pexies" to change them. Should we resort to such operations before these anomalies cause trouble? There is no doubt but what they are created in utero, continue thereafter, and that many are harmless. If, in a given case, we find displacement of the intestinal tract, or a displacement of any portion of the colon, we must not assume that the displacement, of itself, is a causative factor of the disease, or of the symptoms. If we are to consider them from an evolutionary point of view, we must accept the theory that in many the changes take place in passing from quadrupedal to become pibedal. Undoubtedly they are responsible for obstruction in a great many cases, but when should we operate, or disturb them in any way? Shall we interfere and produce a condition that does not benefit? A good deal is said today about omentopexy, gastro-omentopexy, colopexy, and sigmoidopexy, and their results; but there are many that should not be interfered with in any way whatsoever. The question should be carefully considered before interfering with them, and it should be thoroughly discussed here, as was done in the proctologic society, twelve years ago.

I heard one of the most prominent surgeons of the country say, when he was confronted with the specimens exhibited by

Dr. Pennington showing the sigmoid lying to the right of the median line, that he had for thirty years taught that the sigmoid never extended beyond the right of the median line, but that he would now be compelled to change his teaching.

So the questions arise: What is the normal condition? When is it abnormal? And if it is abnormal, when does it produce conditions which will warrant or justify one in resorting to surgery? s

Dr. Herman E. Pearse (Kansas City, Mo.): I have only a word or two to say with reference to this matter which, I believe, is of greater interest than any other one topic that is before us, or has been before us in the last few years. I would like to take ten or fifteen minutes to indicate some facts in regard to displacements of the colon, but much that I shall say will have reference particularly to the clinical aspects of the cure.

I started to work a few weeks ago examining a lot of healthy men by means of the fluoroscope and the *x*-ray, and I am finding out remarkable things with reference to displacements of the colon. I think we can find as wide displacements of the colon in those individuals who have healthy bowel movements as in those we have been examining for pathological conditions of the colon. I shall be able to tell you more about this when we get through with the examinations we are conducting today.

With reference to these cases in which we find the so-called membranous pericolitis of Jackson, the band of adhesion of Lane, the fixation bands, and so on, they are to my mind manifestations of peritonitis, as we learned it thirty or forty years ago, when we were told that peritonitis was plastic or suppurative. This is a plastic peritonitis from toxemia. The toxemia is the result of stasis of the colon, and by means of bismuth tests and the use of the fluoroscope we find that stasis of the colon is a condition not dependent upon a displacement of the colon. It is a concomitant of displacement, and I question if it is to be considered the result of a displacement. The relief of the condition, as we have found it in actual practice, has been mighty pleasant, where we have followed out the following lines of treatment: Having determined the condition, the patient has been placed in the exaggerated knee-chest position, pitched over on the face, and required to indulge in deep-breathing exercises for a number of minutes, several times a day. Having accustomed them-

selves to these gymnastic exercises, we put on Rose's adhesive belt, or a strong steel brace buckled around the pelvis, as advocated by Longyear, of Detroit, formerly president of the American Association of Obstetrics and Gynecologists. After these two procedures we use paraffin oil or a vegetable oil, olive oil and paraffin oil mixed, or paraffin oil and castor oil mixed, but it is a question whether the patient requires a purgative alone, a lubricant alone, or a mixture of purgatives and lubricants. This lubrication, instead of drastic purgation, added to the belt, cures a great many of these cases. In those patients who are not relieved by these measures we short-circuit the ileum. The ileum is divided eight inches from the ileocecal valve, or where it lies nicely against the sigmoid or whatever portion of the large bowel is found to be normal, and there anastomosis is done.

Let me say with reference to the anastomosis without division, that it is of no use clinically. It has failed in every case where we have made the anastomosis without separating the ileum. To simply make the anastomosis is of no value. Whenever the ileum is separated and an anastomosis of the ileum and rectum, or the ileum and lower sigmoid, is made, the head of the colon should be pulled down into the right iliac fossa and a colostomy should be done.

FAILURE OF THE COLON TO ROTATE

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A certain percentage of surgical operations are performed for the relief or correction of conditions due, directly or indirectly, to some congenital deformity or faulty development of the fetus. The greater number of these defects are usually distressingly apparent, and in these cases surgical aid is sought early, with the hope that the deformity may be reconstructed and reduced to a state as nearly normal as possible. The common afflictions, such as harelip, clubfoot, imperforate anus, anomalies of external genitalia, etc., usually come under the surgeon's care in infancy or early childhood; but within the abdomen congenital deformities are so efficiently concealed that only a small percentage of them are found until adult life is reached, and then only at operation or autopsy. The various phases resulting from non-obliteration of the vitelline duct, dermoid cysts, anomalies of the female genitalia, and variations in the position and relationship of the large intestine, are familiar examples of these conditions.

The relative rarity of these obscure intra-abdominal abnormalities and the fact that they so infrequently give rise to definite symptoms, explain in part why a diagnosis is so seldom made when trouble occurs. However, within recent years the increase in the number of explorations for obscure abdominal conditions, and the enormous increase in operations performed on the intestine for a definite purpose, make it imperative

that the surgeon become familiar with anomalies of the abdominal contents, having in mind the possible conditions.

In case of the large bowel, for example, there may be complete transposition of the viscera. The whole of the colon may be on the left side of the abdomen through failure to rotate in its early development. A partial rotation may leave the cecum at any point between the normal and the right under-liver position, or the left umbilical position and the left pelvic. Because of congenital or acquired openings in the diaphragm much of the colon, with other abdominal viscera, may be located in the pleural cavity.

The primitive alimentary canal is a midline vertical tube connected to the spine by a fold of peritoneum. Later the primitive stomach appears as a bulbous enlargement of it in the upper abdomen, while the lower portion retains its connection with the spine and becomes the descending colon and sigmoid, as well as the left part of the transverse colon. Their blood-supply is derived from the inferior mesenteric artery. In the portion of the primitive gut between this part of the colon and the stomach-bulb, another small bulbous enlargement appears near the central portion, which indicates the developing cecum. This distal portion, or colonic section, enlarges slowly in comparison with the proximal or small intestinal area, and all of this midsection has a common mesentery supplied by the superior mesenteric artery.

With the rapid growth of the small intestine and the slow growth of the large intestine, a rotation of the mesentery occurs, and the colon, being wholly on the left side of the spine, rotates about the mesenteric axis, the cecum passing across the duodenum to the right hepatic position and descending to the right iliac fossa. By the eleventh or twelfth week the cecum lies

immediately beneath the liver and to the left of the midline. It travels to the right, crossing the descending duodenum, and at the fourth month is found lying on the right side just beneath the liver. From this position it descends slowly to its adult position, which it usually approaches toward the end of fetal life, but it may not actually reach this point until some time after birth. (Cunningham.) While ordinarily the rotation may be nearly or quite completed before birth, it may fail to occur at all, or it may be arrested temporarily or permanently in any position during its circuit.

In the event of any of these abnormalities, the following complications may arise:

1. Failure to find the appendix at operation, or it may be found in the retrocecal or in the hepatic position, or it may be in the superior midline adherent to the gall-bladder, duodenum, or stomach; or, again, it may be found to the left of the umbilicus or in the middle of the left pelvis.

2. In the complete failure of the colon to rotate, the duodenum is movable and has a mesentery, and merges directly into the jejunum uncovered by the transverse colon or its mesentery. The condition should be considered *probable* when no colon is found on the right side, and *positive* if the duodenum be found as described above.

3. Failure of the colon to rotate should be considered as a possible cause in cases of obscure inflammatory conditions in the left or middle pelvis, or in the left iliac fossa, particularly in the young individual. In the middle-aged and older individual, with left-sided inflammations, it should be considered a possible condition and should be differentiated from malignancy, diverticulitis, and complete transposition of the viscera.

Approximately 300 cases of complete transposition

of the abdominal viscera have been reported in the literature. In six cases which were observed at St. Mary's Hospital, three were operated upon for left-sided appendicitis, two with acute abscess.

Very little is found in the literature as regards failure of the colon to rotate, although it is undoubtedly a condition which should be considered as more frequent than complete transposition. The condition will be found described under various anomalies of the duodenum, as well as of the colon. We have observed five of these cases during the past two years, and in only one of the cases was the abnormality diagnosed before operation. The points noted in this case were: (1) Difference in colonic percussion-note over the whole of the left side; (2) general intestinal distention, and during attacks distress in lower transverse abdomen; (3) irritation of the stomach and obstipation of a pelvic appendicitis. The conditions were not acute at the time of observation, as they were in two of the others, and after a forced, thorough intestinal evacuation a bismuth acacia soup was administered, and a series of interval radiographs were made which pictured the abnormal condition of the bowel as disclosed by its transit.

While the condition had been previously observed in the clinic at St. Mary's Hospital in the course of routine abdominal operations, some of the puzzling features in connection with the following five cases have influenced us to report them somewhat in detail. These cases are not of the partial rotation type, but rather of complete failure of the cecum to leave its earliest situation on the left iliac side.

Dr. G. E. Armstrong and Mr. John D. Malcolm,*

*Armstrong: "Abnormal Position of the Duodenum." Trans. Am. Surg. Ass'n, xxviii, 1910, p. 299-307.
Maylard: "The Surgery of the Alimentary Canal," 1896, p. 480-483.
Malcolm: "Two Rare Abnormalities Observed in the Course of Operations," *Lancet*, Nov. 18, 1911, p. 1401-1402.
Huntington: "Anatomy of the Peritoneum."

in two comparatively recent articles, have taken up the subject from the standpoint of abnormalities, reporting cases observed in the course of operations.

Case 1.—(37,121), C. O., male, aged nine years, Consultation April 29, 1910. Previous history not important. When first seen the patient had been suffering for twenty-four hours from severe cramplike pains across the lower abdomen, with no definite localization. Vomiting, fever, and rigidity gave evidence of an acute inflammatory process, probably appendicitis, and immediate operation was advised.

Operation, April 29, 1910. A split-muscle incision was made, and free turbid fluid encountered. Although the incision was enlarged, only small intestines were seen, and no trace of the large bowel could be found, but the duodenum merged into the jejunum uncovered by the colon. Suspecting an anomaly, another incision was made close to the midline, and the cecum with an acute gangrenous appendix was found lying in the left iliac fossa with the tip of the appendix lying over the left pelvic brim. The appendix was removed with considerable difficulty, and the patient recovered after a rather stormy convalescence, during which temporary enterostomy was required. A radiogram taken some time after operation (Fig. 1) shows the cecum in the left pelvis and the whole large intestine to the left of the median line.

Case 2.—(47,195), G. A., male aged forty-two years. Consultation December 20, 1910. There had been no marked bowel symptoms. A diagnosis of gastric ulcer was made, based on a definite history extending over some twelve years.

Operation, December 29, 1910. A general exploration disclosed a chronically inflamed appendix lying in the left pelvis with the cecum and ascending colon on the left side. The appendix was removed. An ulcer was found on the lesser curvature of the stomach, which had perforated to the pancreas, and a partial resection of the stomach was necessary to remove it. Gall-stones were also present, for which a simple cholecystotomy was done. Microscopic examination showed early carcinoma of the stomach. The patient made an uneventful recovery. No radiographs were obtained in this case.

Case 3.—(55,210), W. G., male, aged twenty-four years. Consultation, June 28, 1911. Referred by his home physician for recurring appendicitis. The history obtained from this patient was definite, and during an attack his physician had

elicited the point of tenderness in the right iliac fossa extending over the pelvis.

Operation, October 4, 1911. The usual McBurney incision was made, but diligent search failed to reveal either the appendix or any part of the large bowel. This, and the fact that the duodenum was not covered by peritoneum, suggested a non-rotation. A low midline incision was made and the cecum and appendix were found in the left iliac fossa. The appendix was subacutely inflamed and was removed. Recovery uneventful. Radiograph (Fig. 2) taken after the patient left the hospital shows position of the cecum and ascending colon in the left abdomen.

Case 4.—(59,276). E. C. W., male, aged sixty-two years. Consultation, September 25, 1911. A history was given of long-standing abdominal cramps, without definite location, and associated with jaundice of a varying degree.

Exploratory operation, October 4, 1911. A thick-walled gall-bladder buried in adhesions was found. The pancreas showed a moderate hardening. The condition apparently being due to a recurring cholecystitis, the gall-bladder was drained. In the course of exploration it was noted that no colon was apparent in the right upper abdomen, the duodenum being uncovered by the colon and having no mesentery. Search was made for the cecum and it was found in the left iliac fossa. Radiographs taken after the patient left the hospital (Fig. 3) represented conditions as noted above.

Case 5.—(60,378), J. L., female, aged sixty-two years. Consultation, October 21, 1911. The patient gave a history extending over some years of attacks of cramps of short duration in the epigastrium, with jaundice, fever, and chills. Following these attacks there was a local tenderness in the epigastrium for two to four days. The symptoms were inconstant, they were not suggestive of any definite upper abdominal lesion, and the possibility of some reflex disturbance was considered. During routine examination a distinct point of tenderness was found in the left lower abdomen corresponding to McBurney's point of the right side. The patient had a uterine fibroid of which she was made aware, and a laparotomy was advised. All over the left abdomen a high degree of tympany was elicited, and some anomalous condition was suspected, possibly an appendix lying in the left pelvis. A series of radiographs were made after a meal of bismuth (Figs. 4-9), and the whole extent of the colon was found lying in the left of the abdomen.

Fig. 1—*X*-ray, No. 13694. Plate No. 6 of bismuth series. Condition 24 hours after bismuth breakfast. Note shadow of entire colon coiled in left lower abdomen and pelvis. A single loop projecting an inch to the right border of the spine. Condition found previously at operation.

Fig. 2—*X*-ray No. 13585. Plate No. 4 of bismuth series Condition seven hours after bismuth breakfast. Note the entire colon to left of midline. A small loop alone projects one inch to right. No bismuth present in small intestine. Condition confirmed subsequently at operation.

Fig. 3—*X*-ray No. 13623. Plate No. 5 of bismuth series. Condition eleven hours after bismuth breakfast. Note position of entire colon to left of midline. Even more pronounced a condition than case No. 59276. Patient weighed over 200 pounds and had a large pendulous abdomen. Confirmed at operation.

Fig. 4—*X*-ray No. 13650. Plate No. 1 of full bismuth series. Radiographed immediately after ingestion of a bowl of oatmeal with subcarbonate of bismuth and cream. A cup of coffee and buttered toast completed the breakfast. Entire series reproduced in positive prints. Note position of stomach filled with bismuth. Curve of duodenum indicated by arrow. Note bismuth in dependent portions of small intestine. Arrow on left indicates gas in splenic flexure. Contrast with Plate No. 2.

Fig. 5—*X*-ray No. 13650. Plate No. 2 bismuth series. Radiographed one hour after Plate No. 1. Stomach half empty. Arrow indicates duodenum. Note mass of small intestine low in true pelvis.

Fig. 6—*X*-ray No. 13650. Plate No. 3, bismuth series. Radiographed four hours after breakfast. Upper arrow indicates duodenum, arrow below shows trace of bismuth in stomach. Note two upper arrows on left side pointing to the two flexures. Gas in splenic flexure, bismuth in hepatic flexure. Lowest arrow on left indicates cecum; above it note position of ileocecal juncture, indicated by arrow. Contrast with Plates 4, 5 and 6.

Fig. 7—*X*-ray No. 13650. Plate No. 4, bismuth series. Radiographed seven hours after breakfast. Single arrow on right indicates trace of bismuth in duodenum. Stomach and most of small gut empty. Terminal portion small intestine indicated by arrows. Upper two arrows on left indicate flexures of colon. Entire colon coiled up in the left iliolumbar region.

Fig. 8—*X*-ray No. 13650. Plate No. 5, bismuth series. Radiographed ten hours after breakfast. Note trace of bismuth in small intestine. Entire colon coiled in left iliolumbar region. Arrows point out the two flexures of the colon. Contrast with Plate No. 6

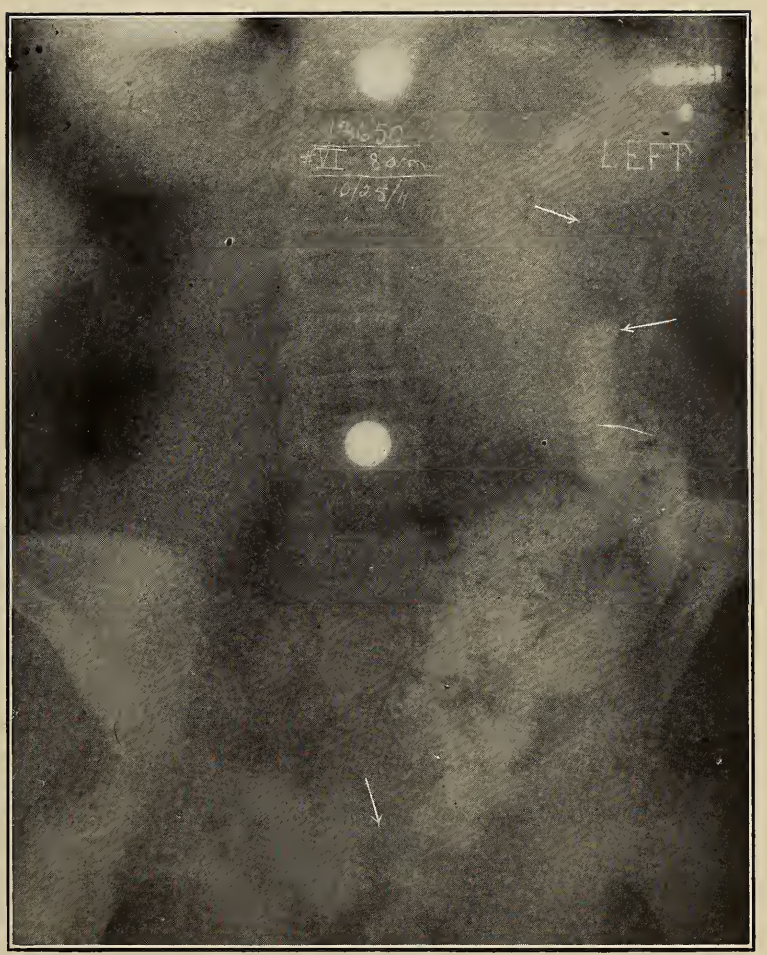

Fig. 9—*X*-ray No. 13650. Plate No. 6, bismuth series. Radiographed 24 hours after breakfast. The colon has straightened itself out since Plate No. 5 was radiographed. Note absence of usual curves of sigmoid. Arrows indicate position of the two flexures. In this case colon is more strongly to the right of the spine than in either of the other cases demonstrated. Condition confirmed at operation.

Operation, October 31, 1911. A median incision was made, and the stomach and gall-gladder were found normal. The duodenum, as in the other cases, was uncovered by peritoneum. The cecum and the ascending and transverse colon were found in the left abdomen, a condition practically identical with that in the foregoing cases. The appendix was adherent and contained fecoliths, and was removed. A pedunculated fibroid, attached to the fundus of the uterus, was removed by myomectomy. The patient made a satisfactory recovery.

DISCUSSION

Dr. Daniel N. Eisendrath (Chicago): I have been very much interested in this subject for the past two years or so, and I read a paper on the subject at the December meeting of the Chicago Surgical Society. I regret I did not bring along the illustrations which show very well the conditions as found at operation in five cases of acute appendicitis connected with non-rotated or movable ceca. We must pay more attention to this subject than we have in the past, for the reason that it is directly connected with a great many unsatisfactory results that we obtain after ordinary appendectomy. In order to systematize the subject, it has seemed necessary to me, especially after hearing the paper today by Dr. Black, to divide the subject into three classes: first, cases of acute appendicitis with or without abscess formation in the non-rotated cecum; second, cases of acute appendicitis with or without abscess formation in the movable cecum, and, third, cases called by the Germans cecum mobile, or movable cecum, to which we must add, as Dr. Black's paper has exemplified, cases of movable sigmoid.

To take up the first class, which Dr. Judd has described, I have had a number of cases of appendicitis, with or without abscess formation, altogether three of this variety, where the abscess was found close to the lower edge of the liver, the appendix pointing upwards towards the subphrenic space, and in the other cases it pointed a little downward. The three cases of appendicitis with movable cecum were similar to those Dr. Judd has described, where upon opening the right iliac fossa the cecum was found not present. I followed a rule in these cases that when I did not find the cecum in the right iliac fossa I began at once to look for the hepatic flexure, and followed the ascending colon right down to the left iliac fossa.

So far as these cases are concerned, they differ from ordinary cases of appendicitis only in their location.

In regard to Dr. Black's paper concerning cases of movable sigmoid, there is much discussion going on in the German literature at the present time regarding *x*-ray diagnosis with the ingestion or enemata of bismuth, and the subject is far from being settled. What causes these ceca to become pathologic seems to be debatable. The cecum, on account of having an increased swinging motion, probably becomes kinked at the hepatic flexure, and as a result of the stagnation we have migration of the micro-organisms through the wall of the gut, which has been described by Dr. Black in relation to the sigmoid, and of which the membrane of Jackson is but a stepping-stone. These cases frequently present the clinical picture of appendicitis, but when the appendix is removed, where there is a movable cecum, with inflammation, the patients return with the same symptoms. These cases, as in one of my own, are accompanied by the symptoms Dr. Black has referred to in connection with the sigmoid, namely: intermittent, colicky pains, attacks of constipation and diarrhea; and the *x*-ray will show that the cecum, where bismuth has been used, is not in its normal place.

In regard to the treatment, in several instances we did nothing else but remove the appendix and let the patient alone for further observation. With the exception of one case, these patients did not complain of symptoms afterward. It is a question, therefore, how much the symptoms are due to the movable cecum.

Now, the question raised by Dr. Pearse as to whether cecopexy is of any benefit in these cases naturally comes up in relation to what I have just said, but what I have never satisfied myself about. Every type of anastomosis has been tried, and further experience will show we are going a little too far. Only recently I heard of one case in which an ileocolostomy was performed for the condition I have named, movable cecum, and the patient has had a distressing symptom in the shape of a persistent diarrhea. We must think of the fact that the contents of the small bowel get into the large bowel much sooner than they ought to, and we ought to go slowly in advising radical operative interference in those cases.

Dr. C. E. Ruth (Des Moines, Iowa): I have been much interested in these papers, for the reason that I have not had

much experience with reference to abnormal positions of the colon, having seen but one case in which the appendix was on the left side. I have seen the sigmoid, however, with so long a mesentery and so frequently on the right side, that it does not cause me any second thought; but the thing that has impressed me more than anything else in connection with these papers is the necessity for being a little more careful, in going a little more slowly in the matter of our operative procedures, and in studying these cases more.

So many of us are put under pressure to do operative work at once, without thorough investigation, that it is very hard to refrain from it. It is unnecessary to comment on the reason why, but, it seems to me, as the years go by the need becomes more apparent to get each case in the hospital where we may study it a little longer when necessary before undertaking operation. I have been impressed especially in the last few days, and in these papers, with the necessity for the use of the *x*-ray, in view of the fact that *x*-ray pictures are better now than they have been in the past. Exposures can be made now in a very short time, the plates can be developed without the necessity for a dark room, reducing the expense to an almost infinitesimal amount, taking little time, and making it almost imperative that we shall do much more of this class of work as a precaution against unnecessary operative interference.

Dr. Amos W. Abbott (Minneapolis): It has been rightly said that we have been finding out a good many things lately in reference to the contents of the abdomen, and especially in reference to the movable organs.

Last week I had occasion to open the abdomen by a right rectus incision, in two cases where the cecum was very movable, and, having this thing in mind particularly, examined the mesocecum, and found that I could lift the cecum out of the wound and pass it with perfect ease clear over to the left side of the abdomen. I believe that a great many of these cases are simply overlooked. Whether they do any harm or not, is a question still under discussion, as we have seen here today. You may call them anomalies, but we do frequently find them.

A year ago I had occasion to examine a great many fetuses for the location of the appendix, and in doing so found that the cecum, contrary to what I had been taught, had descended in all the cases as low as its normal position, by the fourth month, but in none of them did I find a lengthened meso such

as we see in all cases of the kind described by the author of the paper. As far as it goes, this is evidence that the condition is not congenital.

In all of these cases we find that the nephrocolic ligament is also lengthened, and that the kidney on the corresponding side is pretty low down.

Dr. O. Beverly Campbell (St. Joseph, Mo.): I think the recent developments in intestinal pathology have taught us a great lesson. The time was when the surgeon thought he had done his duty when he had made the McBurney incision through which the appendix was removed, without any further effort at the discovery of additional pathology. The work of Jackson and of Lane showing the existence of kinks in the ileum has demonstrated that very much more is necessary than the mere removal of the offending appendix.

The character of cases reported by the two essayists clearly shows that it requires a great deal of knowledge of pathologic lesions within the abdomen for one to do successful work. The McBurney incision should never be used except in simple cases of appendicitis, where we are very sure of the pathology. The right rectus incision affords plenty of room so that complete work may be done.

Recently I had two cases of abnormality of the colon. One was a case of acute appendicitis in which I opened the abdomen along the border of the right rectus, and found what I believed to be the cecum, but upon examination it proved to be the sigmoid flexure and it was in the iliac fossa. I also found the great omentum was adherent in the right iliac fossa, and after freeing the omentum I liberated the sigmoid and found the cecum beneath it in its proper position.

About two months ago I operated upon a young man with curvature of the spine, who was suffering with acute obstruction. The obstruction was due to a band stretching from the left epigastric region downward toward the right iliac fossa. The band proved to be an elongated appendix and the cecum was located to the left and above the navel.

I agree with those who are advocating thorough, complete work in removing the appendix. There are many cases in which we can with safety liberate all of the adhesions and intestinal kinks that are found to exist, and by doing so we forestall the occurrence of intestinal obstruction.

Dr. Donald Macrae (Council Bluffs, Iowa): I do not rise to discuss the paper, or to throw any light upon the subject, but simply for personal information. It seems to me we have possibly forgotten some of the points that Dr. Black made in his paper. As I understand, these two papers in one sense deal with the same subject, that is, malformations of the abdominal viscera; but in addition to that, Dr. Black drew a picture of the organic condition present, which has nothing whatever to do, in my opinion, with the abnormality. The same condition may obtain in a normal condition of the intestine. Therefore his paper, from my standpoint, deals with two conditions; one abnormal, and the other normal, pathology, if I may so use that term; that is, pathology we may find with an abnormal condition, plus a normal condition.

I have no idea that this abnormality has been a causative factor in the pathology he found at the time of operation. I have seen several cases where the colon was in the region of the hepatic flexure, with conditions similar to those which the doctor spoke of, insofar as the organic pathology is concerned. Therefore it behooves us, first, to be on the lookout for abnormalities, and, second, to deal with the condition such as the doctor found at his operation. If the condition he found was normal, what was the causative factor in the production of the disease? He does not seem to think that the Jackson membrane had anything to do with it. I cannot help but believe that the Jackson membrane, which Dr. Jackson described so clearly and beautifully in a paper he read before this Society a few years ago, has a great deal to do with this matter. I have been much impressed, since Dr. Jackson's paper, with the presence of this membrane. I have since seen a great many cases with this membrane where formerly, it seems to me, I never saw it.

As to the McBurney incision, I think it is contra-indicated in almost any of these operations. I do not think a man is justified in making it. He does not know the pathological condition he has got to deal with, and this incision should not be made unless a man is absolutely sure of the conditions he has to contend with, and in this connection, I may say, we are not sure of a thing in any case of surgery we go into. In some cases, when I make a long incision through the right rectus, I find the membrane that Dr. Jackson has described. It is more marked in some cases than in others. It is like a napkin wrapped around the intestine. In considering the paper of Dr. Black we have two conditions, one an abnormality, and

the other a pathologic condition which has nothing whatever to do with the abnormality.

Dr. Jabez N. Jackson (Kansas City, Mo.): I hesitate to take part in this discussion, for the simple reason that the papers of Drs. Black and Mayo are considering purely congenital or other displacements of the colon, which in my judgment, have absolutely nothing to do with a discussion of the question of movable cecum or membranous pericolitis, which I described some years ago. I believe that the condition described as cecum mobile, and the one which I described before the Association several years ago, are conditions absolutely unlike and apart from any of the conditions of abnormal development or actual rotation of the colon. It is a pathological condition of the ascending colon and perhaps exclusively confined to the ascending colon. It is a pathological condition that is caused by the development of a vascular membrane outside of and circumscribing the ascending colon above the cecum and from above it to the hepatic flexure, and rarely including the cecum at all.

I am satisfied in my own mind that the Germans, beginning with Wilms, in writing about cecum mobile have described a condition which is the same as I described under the head of membranous colitis, because, you will remember, I spoke of the fact that the cecum was always distended in these cases of membranous pericolitis. I explained the fact of dilatation of the cecum as a sequence of constriction of the membrane above, so that the term cecum mobile, in my judgment, refers simply to one symptom, the sequence to another condition, and that condition is the membrane I have described. In a more recent article by Wilms he has alluded to the fact that he has discovered a vascular membrane above the cecum. As to the probable etiological factor, I have looked upon membranous pericolitis as inflammatory in character, due to bacteria of a low grade of activity, or more probably due to the penetration of toxins through the gut in this portion. We are all aware of the fact that absorption takes place more in the ascending colon than anywhere else in the intestinal tract, and hence there is an excuse for the penetration of the toxins or bacteria from this portion of the intestinal canal. With the reaction we have the development of a membrane which shows fibrous tissue, which unquestionably must arise from a low grade inflammatory condition, and is therefore neither a congenital condition nor one acquired by traction, as has been explained by Lane.

Acting upon the theory that the symptoms arising from the membrane were those of constriction, I suggested stripping off the membrane at the time the operation was done. The question arose in the minds of a good many as to what would happen if this membrane were stripped off, and whether adhesion would take place after the removal of the adventitious membrane. At that time I could not answer the question. Since then I have had the opportunity of opening the abdomen of two of these patients, and I want to say to you, not the slightest adhesions have formed as a sequence of this extensive denudation of the colon. This procedure has given me seventy per cent of cures. Wilms has given a high percentage of cures in the treatment of cecum mobile, by performing cecopexy, and the question arises in my mind whether we are able to secure these results by cecopexy without the removal of the membrane, and if so, how. Cannon has shown that the intestinal muscle, when in a state of tonus, responds to stimulation from within and results in the establishment of a peristaltic wave. If the normal tonus of the muscle is overcome by stretching, there is no response whatsoever to the stimulation, and no peristalsis. That being the case, we can readily understand how, primarily, when the obstruction above is the result of a constricting membrane producing dilatation of the cecum below under the retention of feces and fluids and gas in the cecum, the cecum finally distends until the muscles are so stretched that the tonicity and contractility of the cecum are lost. That being the case, in cecopexy, by shortening the muscles at the point of attachment, we enable the cecum to resume its contractile power and thus to force the contents on if the obstruction is not very great. The question has arisen whether in the course of time these cases of cecopexy are going to be cured permanently. If there is remaining obstruction above, we would expect recurrent dilatation of the cecum and renewal of the original disturbance. Recently I have made use of two things; stripping of the membrane and cecopexy, the latter being effective, in my judgment, after the constriction has been removed, but not unless that has been done.

Dr. L. L. McArthur (Chicago): As a father rises to defend his child, I rise to defend what my colleagues from Chicago have given me the credit for, namely, doing the first muscle-splitting operation, and of having done it three years in advance of McBurney, reporting fifty-three cases before he had reported any; but unfortunately my paper was last on the program, and came late. The Society adjourned until

October, and Dr. McBurney *published* his paper before I did mine.

I would not like to see the statement go out from this Association, without some qualification, that the McBurney incision should *never* be used. It is certainly one of the most desirable incisions that can be made in any part of the abdominal wall. A McBurney incision can be converted into a modified right rectus margin incision by simply enlarging the incision up and down, and you have the same incision plus a little separation of the muscle fibers; or, where you need to enlarge it slightly, you can cut the tendons of the internal oblique and transversalis, leaving the external oblique, which is the strong fascial layer, held apart by means of retractors, and still have one layer of tendinous tissue to keep the wound from gaping and causing a hernia, so in that situation you can accomplish about what is accomplished by making a right rectus incision.

Dr. Chas. E. Bowers (Wichita, Kan.): Inasmuch as the term membranous pericolitis signifies an inflammatory condition around the colon, it occurs to me, this being a scientific body, that until some pathologist has demonstrated that it is the product of inflammatory process, the application of the term membranous pericolitis to this condition is not only non-scientific in view of our present knowledge, but misleading. Therefore, the term should not be thus applied. It has not been proved pathological in character. It may be that we are dealing with a malformation of the peritoneum of congenital origin.

Dr. Arthur E. Benjamin (Minneapolis): I have found in my own experience that in nearly all of these cases in which this membrane has been found it has been accompanied by a mucous colitis. I have studied these cases in the last two or three years very thoroughly, and I find in nearly every one of them, after asking questions with reference to the passages from the bowel, there are times when they pass large quantities of mucus from the bowel. I have found that this inflammation around the colon and cecum would disappear by flushing the colon once or twice a day, and putting the patients on the olive oil treatment, lubricating inside the intestinal canal, putting the patients in the exaggerated knee-chest position, and having them sleep with the foot of the bed elevated from six to fourteen inches. This takes out the ordinary angles of the colon, and the bands of adhesion which have held the transverse colon down will gradually disappear in a great many instances. After a thorough trial of this sort of treatment and

failing, I have then instituted operative procedures to cure the cases in which a diagnosis of appendicitis, with adhesions, or kinks, was made, and which could not be cured otherwise.

INFECTION OF THE RETROPERITONEAL LYMPHATICS

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This subject was so well written up by R. R. Huggins, of Pittsburgh, and published in *Surgery, Gynecology, and Obstetrics* for March, 1911, that the only excuse for bringing it before you is that we may discuss it and that the writer may add his personal experience.

In the retroperitoneal space there are three separate groups of lymphatics: the mesenteric, which receives drainage from the small intestines and a part of the large intestines, and is the common seat of infection in tuberculosis of these parts; the celiac group, which lies about the celiac axis and receives drainage from the stomach, liver, and pancreas; and the lumbar group, which extends along both sides of the vertebral column from the crest of the pelvis to the superior mesenteric artery, and receives drainage from the lower extremities, the uterus, vagina, male generative organs, the rectum, sigmoid, and descending colon. These three groups have channels of communication so that they form a complete chain extending from the depths of the pelvis to the diaphragm and beyond. We are especially interested in the lumbar group because it drains all those parts most frequently invaded by pyogenic organisms.

We are all familiar with perinephritic abscesses and retrocecal abscesses when the appendix is outside of the peritoneal cavity, but, aside from these, compara-

tively few cases have been reported in which the abscess was known to be of retroperitoneal origin. We would naturally expect this large space behind the peritoneum, with its abundant areolar tissue and free lymphatic communication with parts so frequently the seat of infections, to be a very common location for abscesses. The chances are that, owing to the inaccessibility of these parts, infections and even abscesses often occur here that are not recognized. When there is an infection here the intestines usually become distended, which adds to the natural difficulties of examination. When chills, fever, and sweating are present, the cause of which is not found in any of the usual locations, or when these symptoms continue after thorough drainage of pelvic or abdominal abscesses, the retroperitoneal space should be suspected. It is quite possible that in many instances where patients have died from sepsis without the abscess having been discovered, it was located in this region. The presence of tubercular abscesses in this location have been very frequently recognized. The reported causes of non-tubercular abscesses in the retroperitoneal space are typhoid, appendicitis, salpingitis, infection following abortion and parturition, and suppuration of the inguinal glands. In some cases following parturition the infection has manifested itself as late as three months after labor. A few cases have been reported without apparent cause.

The writer's experience is limited to four cases, the first two occurring years ago before laboratory facilities were at hand.

Case 1.—Mrs. K., a multipara, aged 36, began to complain of severe pain in her back and down her limbs a few days after a miscarriage. She had frequent chills, high temperature, and sweating. She was treated by curettage and vaginal douches. The writer was first called after she had been ill for sev-

eral weeks and was greatly emaciated. She then had high temperature and sweating. The abdomen was distended and tender, and the right thigh drawn up. The whole limb was swollen and boggy, suggesting phlebitis, although it was on the right side. By vaginal examination the uterus was found slightly enlarged and movable, and a mass could be felt high up in the right side of the pelvis. This mass could be felt above Poupart's ligament. An incision was made above and parallel with Poupart's ligament, and a large amount of pus evacuated, and drainage established. Numerous openings were made in the thigh and later in the leg, and drainage-tubes introduced. The temperature dropped, and the patient made temporary improvement, but after several weeks died from exhaustion.

Case 2.—A woman, aged 42, had been treated for over two weeks for appendicitis before the writer was called. She then had high temperature, chills, sweating, and a distended abdomen. The tenderness was not marked, and the abdomen had not the feel of a peritonitis, but it was evident that pus existed somewhere deep down in the abdomen. No mass could be detected. An incision was made in the median line. The appendix and pelvis were normal. A fluctuating mass was detected to the left of the bodies of the vertebræ behind the peritoneum and extending between the folds of the mesentery. Drainage was established, but the patient died septic in a few days. A post-mortem was not permitted, and the source of infection was never discovered.

Case 3.—Hospital No. 552. P. D., an Irishman, aged 55, a granite-cutter, was admitted to the University Hospital on April 9, 1910, on account of a large ulcer on the dorsum of the right foot following a burn. The ulcer had existed for ten years and had been treated in a hospital in Montpelier, Vermont, and elsewhere. He had been skin-grafted unsuccessfully. He

is an habitual drinker and is addicted to the use of heroin. The ulcer was first cleansed and treated antiseptically, after which graduated pressure by means of strips of adhesive plaster was tried, but without satisfactory result. Late in November he was skin-grafted with partial success. On January 17, 1911, he developed temperature, and redness over both lower extremities. A diagnosis of erysipelas was made, and he was transferred to the medical side.

On February 6th the patient complained of pain in left groin and deep in the abdomen. The inguinal glands became swollen, and the thigh was flexed. His complaint of deep-seated, very severe pain in the back and abdomen was at first attributed to the fact that the amount of opiate he had been taking had been gradually reduced, but he began to have chills, high fever, and sweating. At first no mass could be detected, but after some time a hard, tender mass could be felt deep down in the left side of the abdomen, and a diagnosis of psoas abscess was made. On February 10th he was referred back to the surgical side. At this time the mass could be felt but was very deep seated. His hemoglobin was 65, and he had a leucocytosis of 12,000. A blood-examination was made with negative result. On March 17th an incision was made along Poupart's ligament, a large amount of pus evacuated, and drainage established. A smear was made from the pus and staphylococcus pyogenes found. On April 13th, twenty-seven days after the operation, he was discharged with the drainage openings and the ulcer on his foot healed. The glands in the left groin were swollen, but did not suppurate.

Should I be called upon to treat a case like this again, I would operate much earlier, making an incision above and parallel with Poupart's ligament, stripping up the peritoneum and establishing drainage outside of the peritoneal cavity, thus saving the patient much time and suffering.

CASE 4.—Mrs. R., a multipara, aged 41, was confined on January 28, 1911. The labor was precipitate, and no vaginal examination was made. She was attended by a most competent and careful obstetrician. On January 30th, four days after confinement, she developed a fluctuating temperature with chilly sensations, but without pronounced chills or sweating. She complained of pains in her back, abdomen, and down her limbs. Nothing abnormal could be detected in the pelvis, but after a time a mass could be felt deep in the left side of the abdomen and the left thigh was drawn up.

On March 10th, when the writer was called, the patient looked pale and worn, was running a daily temperature of 102°, and the mass in the left side of the abdomen was quite prominent. A diagnosis of abscess in the retroperitoneal space was made and operation advised. She was moved to the Northwestern Hospital and on March 11, 1911, an incision was made just above and parallel with Poupart's ligament, the peritoneum stripped back, and a large abscess evacuated. Two large drainage-tubes were introduced. The temperature dropped promptly. There was very free drainage of pus mixed with enough blood to cause some uneasiness, but all went well and in two weeks she went home, and in four weeks went for an automobile ride.

In the pus were found many pneumococci and a few staphylococci. A careful study of the possible sources of infection was made, and it was found that the bed-pan used by the patient was the same one that had been used by her father, who had died of pneumonia a short time before her confinement. It seems rational to conclude that the diplococci were conveyed from this bed-pan to her vagina and thence up through the lymphatics to the retroperitoneal space.

STRANGULATION OF INTESTINE BENEATH A PERSISTENT INGUINOGENITAL LIGAMENT

CHARLES H. WALLACE, M. D.

ST. JOSEPH, MISSOURI

The rarity of the condition has prompted the writer to report the following case:

Male, aged 50, no serious previous illness except in 1891. At that time he was stricken with a sudden, sharp pain in the lower right abdominal quadrant, the symptoms resembling those of strangulated hernia without the tumor. The pain subsided in a few days under rest. A hernia was suspected, and a truss was worn thereafter. On December 28, 1910, while stepping out of a bath-tub, his right foot slipped on the rim of the tub, and a sudden violent, sharp pain was experienced in the right lower abdomen. The pain increased in intensity and in two hours a neighborhood physician was called, and one-half gr. of morphine was given without relief. The symptoms progressing, the patient was seen by the writer six hours after the onset, when examination revealed unmistakable physical signs of strangulation of the bowel. He was immediately removed to the hospital and operation was begun nine hours after the onset of the attack. Owing to the fact that hernia had been suspected for years and a truss worn, it was thought that possibly a small knuckle of gut had become strangulated at the internal ring, although no definite tumor was present; hence, the customary herniotomy incision was employed. Careful search failed to reveal the presence of either

spermatic cord or hernial sac, but there was present in the canal a thin connective-tissue band. A bulging dark-colored process of peritoneum was seen at the internal ring. This was incised, and considerable quantity of serosanguineous exudate escaped. Highly congested bowel could be seen in the abdominal cavity. The absence of the right testicle had been noticed just previously, yet not discovered before the operation. The inguinal wound was quickly closed, and the abdomen opened through the right rectus. Considerable serosanguineous exudate was present in the peritoneal cavity. The upper portion of small gut was greatly distended, and the large bowel collapsed.

After some difficulty it was discovered that a fairly long loop of small gut (ileum) was strangulated beneath a strong band, which extended from a point at the internal ring upward to a structure situated below the right kidney. The strangulated loop belonged to the lower quarter of the ileum. The band, which was tense, non-elastic, and one-fourth inch in breadth, was severed and the gut liberated. The structure above become movable after the band was cut and proved to be the right testicle, which had never descended from its early fetal position below the right kidney. The band was attached to the epididymis and testicle. The latter was fairly well developed and freely movable. It was not removed, owing to the patient's condition. The gut was rather badly damaged, but revived sufficiently to warrant replacing. The wound was closed with a small cigarette-drain in the lower angle. The patient rallied fairly well, but died on the fourth day with symptoms of a violent intestinal toxemia.

The case presents the usual features of cryptorchism with a well-organized embryonic inguinogenital ligament, underneath which a loop of small gut became strangulated while the patient was in the act of lifting his leg. The development of a free band ex-

tending from the retained testis to the internal abdominal ring brought forth some controversy inasmuch as the settlement of considerable accident insurance was involved in the case. It was held, on the one hand, that the inguinogenital ligament, which later became the gubernaculum, exists as a retroperitoneal structure similar in peritoneal relations to the ureter; hence the impossibility of the intestine being caught beneath it. This view appeared to be reasonable until further study was made of the development and descent of the testes. In order to clear up the question satisfactorily a personal letter was addressed to Dr. George S. Huntington, Professor of Anatomy, Columbia University, New York, explaining the findings at operation. His letter of reply will be freely and literally quoted in what follows:

According to Professor Huntington, "There was unquestionably in this case the exceptional condition of cryptorchism, in which the testis remains after reduction of the Wolffian body proper, in relation to the caudal pole of the permanent kidney instead of descending, as it usually does, to the inguinal ring or some point within the inguinal canal." The constricting band was undoubtedly the inguinogenital ligament of the embryonic testis, which normally becomes the gubernaculum. That it existed as a free band capable of strangulating bowel is not remarkable. "All abnormally persistent embryonic structures, which raise the colon lining into folds, tend, if they persist in the adult, to become free structures traversing the peritoneal cavity." This is accomplished by absorption of the thin-layered sheet of colon lining, which forms the foundation of the original fold of embryonic peritoneum developed by the growth of the related structure." An example may be found occasionally in the persistence of a free band extending from some point along the terminal portion of the ileum to the umbili-

cus. This is a fibrous cord representing the persistent omphalomesenteric artery. Very rare is the condition of a persistent band representing the inguinogenital ligament. If persistent, however, the same law of absorption of mesentery has been followed. Originally the mesenteric folds performed a blood-carrying function. "In the case of a descendant and rudimentary structure persistent in the adult, this primitive mesenteric fold loses its original significance as a blood-carrying membrane. The structure to which it originally brought vessels degenerates into a fibrous cord, with very slight vascular relations, and the mesenteric peritoneal fold, by means of which it was originally suspended within the peritoneal cavity, begins to be absorbed in certain regions, producing lacunæ or perforations. Confluence of these areas of absorption tends to the formation of larger fenestra between the parietal peritoneum and the band, and finally by a continuation of this process the band, whatever its original significance and purpose may have been, traverses the abdominal cavity of the adult in the direction of its original embryonic relation and may act as a constricting or strangulating agent if intestinal coils are caught beneath it or between it and the abdominal walls. Professor Huntington states further that "A structure like the gubernaculum composed of connective tissue, and particularly of muscular elements, will, if carried into the adult organization, furnish the basis for a very strong tissue-ligament. An opening formed by absorption over a considerable area in the primitive mesorchial fold connecting it to the parietal peritoneum, will offer an opportunity for the passage of intestinal coils beneath the band and for their strangulation under appropriate physical and mechanical conditions."

Another rather interesting feature in the history of the case was the apparent relaxation of the band while

the patient was in the act of lifting the leg, thus permitting a long loop of intestine to slip beneath it.

I am indebted to Dr. L. A. Good who was associated with me for assistance in this report.

FOR DISCUSSION SEE PAGE 145

A SUGGESTION IN THE TREATMENT OF ACUTE INTESTINAL OBSTRUCTION WITH IMPAIRMENT OF INTESTINAL VITALITY

Van Buren Knott, M. D.

SIOUX CITY, IOWA

As several papers dealing more or less broadly with the subject of intestinal obstruction, are to be presented at this meeting, I shall confine my remarks to a brief discussion of a procedure that has been found of benefit in cases of acute intestinal obstruction when at operation the vitality of the bowel has been found so impaired as to demand resection. No attempt will be made to take up the general consideration of obstruction, from either the etiologic, diagnostic, symptomatic, or treatment standpoint.

It is a well-known fact that the mortality of acute intestinal obstruction accompanied by gangrene of the gut, is extremely high. The condition of such patients at the time of operation is never good, and is frequently desperate. Prolonged operative interference under such circumstances is to be condemned. There are, however, two urgent indications which should be met. One is immediate and free drainage of the intestine, the other the immediate removal of the diseased intestinal and mesenteric area. To meet these indications promptly and with as little loss of time as possible, the following procedure has been employed by me in the last eleven cases of this description.

A large Moynihan or Doyen forceps with rubber-coated blades, has been applied to the bowel and mesentery, well beyond the diseased area. The ends of the segment of intestine to be removed, are now occluded by any crushing forceps, at least one inch from the rubber-coated clamps. The intestine and mesentery between the rubber-coated clamps are now rapidly cut away, the line of incision being about half an inch from the jaws of the clamps. The cut edges of the mesentery are now quickly caught with a continuous lock-stitch of catgut, and both ends of intestine drawn up and stitched into the abdominal incision, care being taken so to close the peritoneum as to permit of no leakage into the abdomen. The rubber-coated clamps are then removed.

The two open ends of the intestine in the wound present much the appearance of the muzzle of a double-barreled shotgun.

No tubes of any kind are inserted into the bowel, and a large dressing is applied. The dressing must be frequently changed, depending upon the amount of drainage from the gut.

Should all go well some ten days or even longer afterwards, depending on circumstances, the open ends of the intestine are liberated from the wound, a lateral anastomosis made, and the abdomen closed.

The time for making the secondary operation must be decided in each case by the surgeon himself, but, as a general rule, it should be done as soon as the condition of the patient will permit, particularly when the line of section has been through the small intestine. Should the small intestine have been opened high up, the patient may be fed by means of a tube introduced into the distal segment of the bowel.

This two-stage operation is recommended for the following reasons:

Free drainage is immediately furnished and maintained.

The rapid removal of the septic gangrenous bowel and mesentery is possible.

An operation sufficiently prolonged to permit of any sort of anastomosis, is, in cases of this type, prolonged beyond the limits of safety, and should the patient survive the immediate effects of the operation, drainage past the point of anastomosis may be incomplete from various causes, among which may be mentioned disturbance of innervation.

This procedure has been employed by me, as stated above, in the last eleven cases of this class upon which I have operated, with four deaths and seven recoveries.

The causes leading to the loss of intestinal vitality in these eleven cases were Meckel's diverticula in two cases; strangulation by bands in three; strangulated hernia in two; severe abdominal contusion in two; thrombosis of mesentery in one; and impaction of a subserous fibroid, with a long pedicle, in the pelvis in one.

These patients were all in desperate condition at the time of operation, and no more exacting test of the procedure could be imposed in a similar number of cases.

DISCUSSION OF THE TWO PRECEDING PAPERS

Dr. M. L. Harris (Chicago): This case is another illustration of an anomalous condition in the abdomen persisting and giving rise to acute trouble. The gubernaculum is an entirely extraperitoneal structure, and should disappear along about birth, in which case there would be no elevation of the posterior wall of the colon or peritoneum. However, if the testicle should not descend, and this band should contract, as normally it is intended to do, it will be seen how it might raise a fold of peritoneum in the posterior wall. The testicle not descending, the function of this band would cease, and, there-

fore, having no longer any function it is probable that the peritoneal layers posterior to it would coalesce and eventually disappear. Whether such peritoneal layers disappear or not, depends on whether the structure has a permanent function or not. For instance, the genital fold in the female forms the round ligament which corresponds to the gubernaculum in the male. These persist, yet we never find the peritoneum coalescing or disappearing about the round ligament nor the suspensory ligaments of the liver, although we have here an analogous condition. Both of these structures have permanent functions. They disappear almost always from the folds passing to the umbilicus because they are rudimentary structures, and should therefore disappear entirely. Of course, it is not expected that a diagnosis of such a condition can be made before operating, but the fact there was an undescending testicle at the age of fifty was sufficient to indicate some anomalous condition and there might be in one's mind the possibility of some anomalous band being present as the cause of the lesion.

Dr. C. M. Nicholson (St. Louis, Mo.): I have had one case along the line of that reported by Dr. Wallace which I believe is unique. The patient, a man twenty-eight years of age, bill clerk by ocupation, was doing work which required heavy lifting the Saturday before I saw him. He attended to his duties during the day, but on Saturday evening complained of pain in the abdomen, which was first general, then localized below the umbilicus on the right side. Sunday morning he was seen by his family physician, and on Monday at ten o'clock was taken to the Rebekah Hospital where I first saw him. At that time the man was vomiting, had a pulse of 140, belly greatly distended, and a temperature of 97½°. I opened the abdomen on the right side through the rectus muscle about its outer border, and there was presented a pathologic picture which was beautiful in the extreme. A structure passing from the bladder to the umbilicus was well marked, and over the structure there was a loop of ileum twisted upon itself. Below, the gut was collapsed, above, enormously distended. The kink of bowel was removed, straightened out, and resected. Some four or five minutes were spent in the hope that its color might return as the result of the application of heat, but as this seemed impossible four inches of gut were removed. The question as to the nature of the structure arose. I believed it could be nothing else than the urachus, though on looking up the matter I found from the literature at my disposal, there was no similar case recorded; that anatomists (beginning with Huntington and going through the list) threw no light on the

matter, except Moll, who treats the subject rather extensively and says, early in intra-uterine life the urachus, which is covered by the peritoneum, is within the belly cavity, that gradually it is brought into and becomes a part of the anterior belly wall. This is evidently a case in which, owing to an arrest of development, the urachus was not brought into the belly wall, but remained within the abdominal cavity. The peritoneum connecting the urachus with the belly wall became attenuated and ruptured. The ileum found its way between this structure and the anterior abdominal wall. The kink of course was responsible for the symptoms which have been enumerated. The patient made a good recovery.

Dr. J. D. Griffiths (Kansas City, Mo.): I have been much entertained by these two papers, and with reference to Dr. Knott's paper on acute intestinal obstruction, I am going to try to illustrate a point which may be of service to some of us. It will be to me, at any rate. I received a telegram from a distance about three weeks ago from a physician stating that a patient with intestinal obstruction was on the way. The patient had been operated on about six weeks previous to this, she having been taken at home with acute pain in the abdomen, which was located a little to the right of the umbilicus, followed by vomiting. According to the doctor's description there was not very much distension. The doctor started with the patient for Kansas City, and while on the way the vomiting suddenly ceased when the cars gave a sharp lurch. The woman was perfectly easy afterwards, and when she arrived in Kansas City she had no trouble whatever. She had no pain, and apparently had no trouble in the abdomen, barring a slight soreness over the surface of the abdomen. I advised keeping her in bed. She remained in bed for three or four days on a light liquid diet because there was some soreness over the surface of the abdomen. The blood count was absolutely normal. Suddenly, after being one week in bed, during the night she was taken with an acute pain again, having, contrary to my orders, eaten a lot of ice cream that evening. I was summoned, went to see her, and found her with a pulse of 160 and in shock. The temperature was subnormal. She was taken to the operating-room at once, her abdomen was opened, and I found a coil of intestine very markedly black. Tracing the coil downward, I found where the appendix had been taken out there was a tight band constricting it at the end of the meson which had become attached closely to the side of the abdomen, and this piece of gut had slipped through and strangulated it right there. The meson being extra long, it

was ligated off by a continuous ligature and dropped, and its distal end had made its attachment, and had given me a pocket on opening through. This coil of gut had dropped and had become completely strangulated. In loosening this the color did not return rapidly, but I waited for a few minutes; the patient was in profound shock; we were giving intravenous transfusion, but she never came out of the shock, and died. Unfortunately I was not able to get the specimen afterwards. This taught me the lesson of attending to the meson of the appendix when it is long.

Dr. C. E. Ruth (Des Moines, Iowa): One point that interests me is with reference to the devitalization of small areas of gut, particularly near the lumen of the gut farthest from the mesentery, because the farther we get away from the mesentery the less the vitality and the less the blood-supply, and I have found in the greater number of my cases that the vitality was threatened to such an extent that we have questioned whether we should do a resection or not. Instead of doing a resection in some of these cases, when there was not too much lumen of the gut involved, I have infolded the gut in such a way as to make an angle, particularly the part whose vitality was somewhat in question, and while it did not constrict in any degree the lumen of the gut if there was sloughing following the folding process, it only increased the lumen and in suturing it I have succeeded in getting a satisfactory result without taking a very considerable amount of time to do it. It is done almost as quickly as we can tell it. While probably others have used the same method, I have not noted it in the literature. This infolding must be done transversely to the lumen of the intestine or stenosis will follow.

Dr. Robert J. Christie (Quincy, Ill.): I would like to relate a little incident that occurred to me some time ago in doing a post-operative repair for strangulation following an acute appendicitis operation. We thought we had relieved the obstruction and closed the abdomen. To the surprise of all concerned the patient kept on vomiting, and the strangulation continued with increased violence. After waiting two days and seeing the absolute hopelessness of the case, we were forced to undertake further search, and this is the point I want to make. After making a median incision and searching the gut, about ten inches from the head of the colon in the ileum we found floating absolutely free, without any attachment to any other peritoneal tissue, a constricting band, resembling as much as anything, except in color and texture, a

rubber ligature, and it was found to be an adventitious band, strangulating a knuckle of gut, which accounted for the acute strangulation. That is easily explained in this way: in attempting to relieve the strangulation and to cure the hernia, the fibrous band was detached and floated away into the interior of the abdomen, and there it was lost and did not attract attention until the symptoms continued and persisted. The question arose again, as that strangulation existed three days, as to whether the gut was viable. After releasing the constriction, and waiting for a few minutes, until we thought it was time to return it, we returned the gut, closed the abdomen, and the patient made a rapid recovery. His vomiting ceased very quickly. I should relate, however, this part of the procedure. Fearing that vomiting might not be relieved, and the patient might have further strangulation symptoms from possible gangrenous infection, we did an enterostomy higher up in the ileum through which the gut was drained and relieved his stomach. It is questionable whether that was necessary. I now think it was not. However, as I have previously said, he made a good recovery.

Dr. W. W. Grant (Denver): The reports of all such cases are not only interesting but instructive, Dr. Knott's cases especially. Dr. Wallace has reported a very unique case, and about it I have nothing to say.

The cases of intestinal obstruction and their treatment constitute one of the most formidable conditions presented to the surgeon, and this condition is not only trying to the patient but very embarrassing to the operator. No matter whether the obstruction is due to paralysis, or to a mechanical condition, immediate operation is the only resource that promises any relief whatever, and it is a well-known fact that the sooner this is done the better the chance for the patient to recover. After the toxemia has become extreme, you may operate and drain, and yet the patient frequently dies, as has been stated, and as has been the experience with most surgeons. I would suggest, feeling it to be safer, to put a drainage tube into each end of the bowel in enterostomy. In this way we will not have an obstruction from contraction of the muscles of the abdominal wall, and we get thorough drainage and evacuation of the intestines, with the escape of the gaseous contents.

If our friend, Dr. Griffith, made any mistake in his case, it was that he did not open the abdomen when the patient first came to Kansas City and was taken to the hospital. Every surgeon ought to be suspicious and fearful as to the condition

with such a history of pain, the pain suddenly ceasing, with a subnormal temperature. It is extremely ominous, as it usually means gangrene and sepsis. We know in gangrenous appendicitis, when perforation occurs, or when gangrene occurs, the pain ceases, and the patient is comfortable; if the surgeon is misled by this and declines to open the abdomen, he will lose his patient. I do not say this in the way of criticism of so excellent a surgeon, but simply to emphasize the gravity of such a history and condition.

Dr. W. D. Haines (Cincinnati, Ohio): I feel that these are important lessons that have been given us, and, as the preceding speaker has said, there are no cases that try one's mettle so much as these cases of acute intestinal obstruction. There is really no hard and fast rule that can be laid down here, as may be said of so many other conditions, but I believe the rule we should follow is the one of getting at the trouble as quickly as we can get our hands upon it; and still, in a case that had been strangulated for seventy-two hours, where we resected forty odd inches of the intestine, and did an end-to-end anastomosis, the patient recovered. But that, I take it, is an exceptional case. However, it was a case similar to those that have been reported here, except it was an ileus caused by adhesions following a laparotomy which had been performed two years previously.

I feel that the method that has been suggested by Dr. Knott is a valuable one. I have in a number of instances of strangulated hernia simply made an incision into the gangrenous bowel under local anesthsia in order to re-establish the fecal current, which is one of the things we must do if we are going to save our patients. We must re-establish the cut-off fecal circulation in the bowel if we are going to save the patient. It is the septic condition which follows, and the influence of this septic condition upon the kidney which overwhelm the patient and cause death. It is this that causes loss of life. So I feel very kindly toward the procedure suggested and adopted by Dr. Knott; first, because it does not require a great deal of time, and, second, because it was successful in his hands.

Dr. Knott (closing the discussion): I have not very much to add. This procedure was suggested to me by an experience that has been more or less common to you all, namely, the natural tendency of all of us usually is, at the first operation, to make a complete operation, to do everything that has to be done. Where resection of the gut is necessary, we naturally think that we do better by making as complete a

resection of the gut as possible, rather than to be forced to the necessity of making a secondary operation. We have no right, however, to consult our own views in this matter, and we must be governed largely by the percentage of recovery.

The case cited by Dr. Haines was very interesting, and the results secured could not have been better. The patient made a prompt recovery; at the same time, in a similar case of that kind, I had a mortality after making a complete operation rather than doing a two-stage operation, as suggested. We have for years failed to remove the gangrenous area of gut, stitching that portion to the wound after opening it, assuming that drainage would take place, but often drainage of the diseased area was not good; the vitality of the bowel was impaired; the peristaltic action was lost, and we were not sure where the amount of intestinal activity above the line of gangrene would begin. Not only is drainage better, but by removing the diseased area of intestine, as suggested, we are not so apt to get the toxic symptoms as we are when we leave the diseased segment of intestine for three, four, or six days. We know most of the circulation between the diseased portion of gut and mesentery has been cut off, but whether it has been cut off entirely we do not know. We do not know how much absorption takes place from it.

FURTHER OBSERVATIONS ON THE REGENERATION OF BONE AND THE REPRODUCTION OF JOINTS

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CHICAGO, ILLINOIS

Nine years ago we did our first operation for the reproduction of joints—an arthroplasty on a hip. Since that time we have changed our tactics and our technic considerably with reference to various joints and have taken up the subject from an entirely different standpoint, namely, the prophylaxis or prevention of ankylosis of joints. We believe, from our later consideration of the subject, that practically all of the ankylosis of joints can be prevented, and that in the great majority of cases the deformities following inflammation in joints can be avoided. We are convinced, furthermore, that the preservation of the normal conformation of the limb in the major portion of joint infections will become imperative on the part of the medical profession.

In order to make the consideration of joints as simple as possible, let me say that in a joint we have but very few tissues that become diseased. The joint is made up of bones and a capsule. Complicated as the joint seems to be infection occurs in one of two tissues as an acute process, in the bone end which is encased in a capsule, or in the synovial membrane of the capsule. The fibrous layer of the capsule is never the seat of primary infective lesions. The cartilage is never the seat of a primary infective lesion; therefore, we have left only the bone and the synovial membrane that may be

primarily infected. The substance of the synovial membrane is the primary seat of metastatic arthritis that occurs in the joint other than that which occurs in the bone. In other words, we have no metastatic infections on the surface of the synovial membrane. We have no idiopathic synovitis any more than we have idiopathic peritonitis. All of the cases of synovial infections, or metastatic infections, or infections from the neighboring bone, or infections from the neighboring structures, are direct infections from opening a joint. The direct infections from opening the joint are the results of microörganisms admitted and the destruction of the endothelial cells that line the joint. The synovial surface is a distinctly protective membrane covered with endothelial cells which perform the same function, to a limited degree only, that the epithelial cells perform on the skin, and that the endothelial cells perform on the peritoneum. It is only after a disturbance of this endothelial layer that we have an infection of the subendothelial spaces by direct inoculation into the joint.

To emphasize this, I will cite some experiments that were made by Dr. Schrager. He injected into a dog's joint half of a syringe-barrelful of virulent pneumococci without disturbing the endothelial cells. The dog went on as though nothing at all had happened. He injected the other half of the syringe-barrelful into another joint of the same dog, and with a fine hypodermic needle tore up the endothelial cells so as to admit microörganisms into the subendothelial spaces, and the dog developed a fatal phlegmon, at the point of the second injection, showing the protection that is given to the joint by the endothelial layer, accentuating, in connection with the synovial membrane, what it took us nearly one-quarter of a century to learn with reference to the peritoneum, namely, that every abrasion and every disturbance of its endothelial layer

increases the liability to infection and predisposes to an unpleasant termination when the endothelium of the peritoneum was disturbed. It also emphasized that, in all our work in the joint, we must avoid disturbing the endothelial layer that lines the joint.

Next, in connection with the metastatic origin of infection of joints, by the colossal number we have now examined, we can come to fairly definite conclusions as to the primary focus of infection, the length of time that elapses between the primary appearance of infection and the secondary manifestation, such as an arthritis, and the type of inflammation that will take place in a joint, a definite type of distal infection corresponding to the germs and tissues involved in the primary infection. The more chronic types are illustrated by the infections in the alveolar process and in the mouth other than those of acute pneumococcus origin. This produces a slow chronic fibrous type of inflammation with an effusion into the joint, just as the lower types of infection in the male urethra produce, after the primary process has subsided, a slow thickening and fibrous infiltration of the synovial membrane of the joint.

The period of time that elapses between the primary infection and metastatic arthritis varies greatly with the type of infection, and that is what has led to the lack of recognition of the connection between the primary infection and the joint inflammation. There is one type of infection that has been standing out conspicuously all of the time, and that is the gonococcus type. Why? Because the inflammation in the urethra continues so long that the man does not forget or overlook the fact that he has suppuration when he commences to have arthritis. In Neisserian infection you practically never have a metastatic arthritis before the eighteenth day, and an enormous percentage of them occur between the eighteenth and the twenty-second

day after the origin of the primary urethritis, or the same length of time following the secondary manifestation of the infection, unless it is of a traumatic type caused by the passage of a sound, where there is an injury to the mucous membrane of the urethra, and then we have a hematogenous metastasis rapidly manifested.

Let us contrast this with the streptococcus type of infection; and in this connection I cannot do better than to cite a case that occurred in the practice of my former colleague, Dr. Neff, of Spokane. A man came out from paying his devotions to the Goddess of Cloacina, had not washed his hands, lit a match on his trouser-seat, and a sliver from the match penetrated his finger. It gave him no particular discomfort through the day. There was no special pain in his finger, but early the following morning he had an intense chill. In the afternoon he had a subpectoral phlegmon on the right side of the chest. That night he had another chill, and he had a second manifestation of effusion and pain in his left knee the following morning. Cultures from the blood, from the chest phlegmon, and from the knee showed streptococci and colon bacilli, showing the speed with which streptococcus infection can be carried from the primary focus into the joint. He never had suppuration at the point of entrance of this sliver, and that is exactly in consonance with our experience.

A woman from Texas on the fifteenth day of an attack of influenza, with the coryza and purulent discharge from the nose continuing, carried an ice-cream freezer on her hip some 150 yards; shortly afterwards she complained of pain in the hip. In a few hours she had a chill. The next morning she had intense headache, and also pain in the hip, developed high temperature, intense septic symptoms, and pain on the slightest motion of the hip. In five weeks she had

complete bony ankylosis of her left hip. This was associating the grippe infection with a trauma, occurring at a period of time when the microörganisms are more commonly circulating in the blood, following a nose and throat infection. The joint manifestations do not occur in any other than the acute streptococcus infections until the time when the primary infection has practically subsided and often is forgotten.

Contrasting a metastatic arthritis and the primary invasion,—when the invasion takes place into the joint, it does not do so on the surface of the joint, but in the subendothelial layer of the joint, where the terminal lymphatics and blood vessels are situated; and aspiration of the joint, in the early stage, in other than the streptococcic type of infection, gives negative findings, so far as microorganisms are concerned. Why? Because the streptococci are the only type of microörganisms that run through the lymph-spaces, and readily escape into the joint. Others are held and slowly advanced to the joint.

You recall the time when we were unable to find tubercle bacilli in aspirations of the knee for supposed tuberculosis of the knee, and that was exactly in consonance with what it should be, because infection in a large percentage of cases occurs in the bone, and effusion takes place in the joint weeks and months before the infection perforates the joint and before the microörganisms appear in the joint, and it is the same type of defensive effusions which we have occurring in infection of tissues surrounded by peritoneum, and long before the microörganisms escape into the free peritoneal cavity by rupture we have a serous or seropurulent effusion poured out.

Now, when you have an arthritis the question arises, is it rheumatism, pure and simple, or is it a metastatic arthritis? In our observation of these cases we have come to this conclusion that there is no such thing

as a definite lesion of rheumatism, and that rheumatism is a metastatic arthritis of greater or less virulency. But we have come to another conclusion. Here is a practical fact, with a metastatic arthritis, or with an arthritis of any kind, when you do not locate the primary source of infection, when it begins with a chill, which is one of the points recognized by the clinicians, it is in all probability going to result in an ankylosis of one or more joints before the process is complete. That is a practical fact.

In examining our cases of arthritis which resulted in ankylosis, an enormous percentage of them were initiated by a chill, and the chill occurred during the presence of an infection distal from the joint. These cases come under the class of the old condition of pyemia. You remember, under this condition, pyemic arthritis did not occur in the early days of the infection, but occurred a long time after the beginning of the infection and showed up as a metastatic manifestation in the joints and serous cavities.

When an infection takes place in a joint, preceded by a chill, with the indication that it is going to result in an ankylosis, how are we going to handle that kind of infection or when the infection occurs by direct transmission into the joint? For instance, if an adze penetrates a joint, and it is followed by a chill, it shows that it has carried in with it infective material. This is followed by rapid effusion into the joint. How are we going to handle such a case?

If that infection occurred in any other position than in a joint, the indication and rule would be to resort to immediate incision and drainage of the infected focus. That would be right and applicable to a joint were it not that there is a definite and well-recognized law that no serous surface can be exposed to the air for any considerable length of time without ankylosis or synechiæ occurring, and if we decided on treating

infections of joints on the basis that we treat infections of the cellular tissue, we must assume at once responsibility and contract with our patients for an ankylosis as an end-result, as is the case in an enormous percentage of drained joints. Therefore, an ankylosis is one of the evil results you can have in connection with an injury to a joint. On the other hand, ankylosis with deformity is still worse, and deformity is the rule when you have ankylosis.

In one of our cases, the patient sustained an injury to his patella. There was an opening of the joint from an external source with infection, drainage having been resorted to. I want to call your attention to the type of ankylosis that occurs here, which differs materially in degree from the types of ankylosis that follow the milder types of infection of hematogenous origin, namely, in the fact that there is a complete consolidation of all bony surfaces from one side to the other.

In another case, the skiagram shows that there is commencing absorption of the patella, because the patella has no further use when ankylosis is established, and in both these cases the patella has practically disappeared by absorption because it is useless. The area of consolidation is greater in these drained cases than it is in the cases of metastatic arthritis that result in ankylosis.

Another case illustrates the effects of an arthritis. It was a beautiful case. The clinical history is as follows: The boy had grip. On the eighth day of the grip he had meningitis, and several days after the onset of the grip and meningitis he had a chill, and then he began to have multiple arthritis, a type of ankylosis which you see in many positions in the body.

Still another case was that of a man who had been treated for rheumatism. His so-called rheumatism began with a chill. He had had influenza for fourteen

days up to the time he had the chill. Following the chill he had pains in all his joints, and when he recovered from his rheumatism, so called, he had ankylosis of both hips and ankylosis of both of his knees, with frightful deformity, subluxation of the knee occurring on both sides. The patella was ankylosed to the femur on one side, but not on the other.

It is my belief that this ankylosis can be avoided by handling the cases in a different way. It is also my conviction that the deformity that has resulted in this case is absolutely and completely avoidable. In the large joints, such as the elbow, shoulder, hip, and knee, you have absolute control of the bones, and all this deformity can be avoided.

Here is the history of another case. A man had "rheumatism," which was preceded by a chill and resulted in an ankylosis. He could not straighten his body, and he could not bring his legs into position. One leg was locked behind the other. He went through life walking with his face to the ground, all of which we believe is avoidable.

How shall we manage these cases primarily, to avoid such catastrophes to the joints? If you have such a case of infection of a joint, remember the law that it cannot be opened and drained; therefore you have to combat infection in every way possible other than by opening a joint and draining it. What can you do?

In analyzing a large number of cases we find that these patients have bony union of only a small area in the joint, in a large percentage of the cases, which is perhaps due to the voluntary contraction of the muscles; that the muscles in their effort at fixation for the relief of pain force the ends of the bones into each other during the inflammatory process, or during the softening and emulsifying stage of the infection by the polymorphonuclear cells with their trypsin in the

early stages. While that pressure continues you have a smelting together of the bones by the destruction of the interposing cartilage, and you have ankylosis over only a small area—I should say, from personal observation, in upward of eighty per cent of the cases. Therefore it is due to what? To the same conditions that favor destruction with infection in every tissue of the body; first, the presence of the products of infection, held under tension; second, the presence of the polymorphonuclear leucocytes, which give up trypsin, that destroys the tissues it is in contact with. Third, by the compression of the articular surfaces by muscular contraction.

It is my belief, therefore, that this ankylosis can be avoided in a large percentage of cases by (1) separating the articular surfaces during the inflammatory process and maintaining separation by a simple Buck's extension of 20 to 30 pounds weight; (2) we are convinced that the destruction can be diminished by repeated aspirations and the relief of fluid tension in the joint.

We believe the character of the joint contents can be altered by the injection into that joint of various medicaments, the one we are still using in the acute cases of infection being a 2 per cent solution of formalin in glycerin. We have used turpentine. We have used emulsions of oil of various kinds, but the best results we have had have been with formalin and glycerin solution, mixed twenty-four hours before its use. Whether that will be the final solution or not, does not matter to us.

What we want to emphasize and bring out is the principle, that the products of infection in the hip and the products of infection in the knee are held there under great tension, and will stand many pounds of hydraulic pressure before the capsule ruptures. The capsule of the joint does not open and let out the in-

fective material like cellular tissue does when you have a phlegmon. Why? Because the capsule is made up of white fibrous tissue that has a feeble circulation. It is difficult to destroy it by infection. It is never the seat of primary infection, and it holds the material there as material is held in any other place. If you get infection in the center of bone, you have rapid destruction of the Haversian vessels and a speedy escape of pus. The joint capsule distends and distends, and it requires so long to destroy the outer fibers of the leathery bottle of the joint that the velvety lining is destroyed long before pus escapes or tension is relieved.

It is my belief that every joint—I am speaking now of major joints, like the wrist, the shoulder, the ankle, the knee, and hip—can have motion restored to it with mathematical certainty by observing a few elementary rules in the transplantation or interposition of tissue. I will confine my remarks now largely to the knee.

When you look at the knee, you see all of the ligaments that are necessary for the mechanical support of the knee within its normal anatomical range. They are the two lateral ligaments, the two crucials and the patellar ligament and quadriceps tendon, all of which must be retained to have the knee-joint pass through its normal function and maintain afterward the proper conformation of the joint. The capsule becomes supportive only when the joint is carried beyond the normal anatomic range of motion. In other words, you can take out all of the capsule around the joint when you have ankylosis and restore it, covering it over with skin, if you maintain the lateral attachments and crucial ligaments, and if you re-establish the ligamentum patellae.

This leads us to speak of operations for the reproduction of motion in ankylosed joints. We shall start with arthroplasties in connection with the elbow-joint.

We have simplified the operation on the elbow-joint.

In our original description of it we took a flap from the triceps tendon. Now, we take the flap from the aponeurosis of the supinator longus, sew it across, after we have chiseled the ulna free, chisel off from one-half to three-quarters of an inch of the humerus, and excavate a cavity on the ulna, so that we have ample room for free motion without compression of the flap when that is interposed within the joint. You need have no fear from infection thereafter. You have cellular tissue to deal with, and if you use ordinary precautions against infection you are perfectly safe in making these transplantations.

A woman was operated on by my colleague, Dr. Neff, of Spokane, on the first day of January, 1911, for bony ankylosis of several years standing. She now has complete flexion of the elbow (after eleven months).

An illustration of a case which gave an evil result to begin with is the following:

In the cases where we divide the olecranon before chiseling the neck free, we use a curved chisel, going in from the inner side, so as to be able to avoid injury of the ulnar nerve, and chisel the olecranon free; then it is separated, the rough surface of bone is removed, and passive motion undertaken. We stretch it and make a V-shaped formation at the end of the bone. In the case of one of our patients, she did not have a bony ankylosis. She had limited motion only after the first operation. In a second operation we took off the tip of the coronoid process and the tip of the olecranon and there is now no limitation of motion, flexion and extension.

Another class of cases is the following:

We have had twelve cases of Volkmann's paralysis following fractures near the elbow-joint, showing how frequent the condition is. Within the last week I

saw one of the most painful examples of it, and that was a fracture in the neighborhood of the elbow-joint, where the doctor, in an endeavor to retain the limb in position, tried to reduce the deformity by putting on a tight bandage. As a result there is now a typical Volkmann's contraction. It is an ischemic myositis with cicatricial contraction, and if the joint is immobilized for a considerable time it always results in ankylosis. In this case there was bony ankylosis. The patient was operated on twice before we got a good result. In these cases we learned a lesson, and that was with reference to the rôle played by the capsule in connection with the character of the deformity. When I examined a boy I felt that he had no bony ankylosis. We elongated the biceps tendon and the forearm moved not more than one-half inch farther than it did before. We exerted still greater pressure and nothing resulted. Examination showed that there had been contraction of the capsule on the interior surface of the elbow-joint, of eleven years duration. The capsule is inelastic. It does not stretch. The bone fractures before the capsule itself ruptures when pressure is put on it. We enlarged the opening on the side of the external and internal condyles, so that we could see through anterior to the joint and between the elbow-joint and the vessels. With a tenotome, we cut the anterior capsule of the elbow-joint clear across from one condyle to the other, and the arm fell down perfectly straight without any resistance. Motion in his fingers has been restored by the elongation of each individual tendon from 1½ to 2¾ inches, at the same time dividing the anterior capsule of the wrist-joint so as to permit of normal extension of the wrist. He is a very good piano player. He has perfect use of each individual tendon and perfect extension of both his hands and elbows.

The next class of cases is very well illustrated in the

infections of the knee. We have had a large number of knee cases. The knee is the most difficult to deal with.

Originally, in our knee cases we took a large flap of fascia from the vastus externus, chiseled the patella free, chiseled the femur free from the tibia, took off a portion of the tibia sufficiently large to permit the joint to be swung around into position, and then interposed the large flap from the vastus externus clear back to the popliteal space. We have simplified that method. I am not going into the technic now, because we have not time to do so, but suffice it to say that the method has been so simplified that any experienced surgeon can do the operation.

In one case, after chiseling the ankylosed patella free, we elevated it, and dislodged it upward and inward. We took off as much of the tibia as was necessary to permit the limb to become straight, cutting from the side leaving the central piece intact where we have the attachment of the crucial ligaments. I took off as much of the central septum between the two tuberosities as I could to permit the limb to become straight. Before doing that, we freed the aponeurosis and the capsule of the joint in a U-shaped flap with the base attached to the tuberosity of the tibia, so that in place of using a large long flap, such as we employed formerly, which requires such an extensive incision, we now use a short flap which requires a much smaller incision, and the operation is much easier to perform.

After that is done, the next proposition is to care for the patella. The aponeurosis and bursa of the patella are left attached to the patella. When we replace the patella after interposing the flap we turn the patella turtle so that the bursa and capsule are turned toward the joint, so as to form a lining for the joint, and the patella, as before. We divide the vastus externus and

internus before turning, leaving the quadriceps intact, knowing it receives but little circulation. These we re-attach after the patellar and quadriceps tendon are rotated. That makes the bursa the lining membrane of the joint. In one case we feared we had met our Waterloo. We came near it. There was ankylosis of the knee at an acute angle. It occurred from infection thirty years before the patient was operated on. She is thirty-seven years of age. A very considerable bowing occurred in the lower end of the femur because she wore a foot extension. She walked with the thigh drawn up at right angles to the body and the leg at an acute angle with the thigh. We took away a large area of the bone to straighten it. We made extension and exposed the vessels in the popliteal space. The next day her foot was edematous and cyanotic, but the circulation was still going on. The following day the foot became still more edematous, and the third day it began to subside. The morning after straightening the limb she had some motion in the muscles of the leg. The next day she had no motion, showing that while the limb stood the extension as far as circulation was concerned, we had stretched the axis cylinders of the nerves, and suspended transmission. There was complete paralysis of flexors and extensors of the foot but that will be restored fully. We have had that experience before in the arm and in the leg, and we fear nothing at all from it. The limb was brought around and put in a straight position. We had primary union.*

Another case in which we were led to do a different type of operation from what we commonly perform was a case of tuberculosis in which the quadriceps tendon was divided some years before and all the articular surfaces were destroyed. The girl was fourteen years of age. The surgeon who operated made a U-

*April 7, 1912, flexion was fully restored and extension was beginning to return.

shaped incision with the base of the U directed upward above the knee-joint. There was an enormous cicatrix above and around the knee when the patient came to us. The question arose as to whether I could get enough of fascia or fat to interpose. I could not get a lateral flap to make a new joint because the incisions came away down on the side and cut off the supply, and it was all cicatricial tissue. In this case I resorted to a method which I figured out long before to apply to this class of cases. I took the trochanteric bursa, that is, the fascia lata, from the hip, cut it out entirely, transplanted it, interposed it clear around and up under the patella, turned the patella turtle, and sewed it all in. We had necrosis of all the old cicatricial scar tissue above, and still had sufficient flap to cover the exposed bone and insure a survival of the interposed flap. Primary union and retention of the flap taken from her hip.

Next, we shall consider the management of the ankylosis of the hip. The hip, when it is ankylosed, is one of the easiest of all joints to deal with, and yet one of the most important joints on which an operation should be done. In the first place, you have always a splendid flap at your disposal, a flap of the fascia lata from the trochanter major, which you can insert in the joint as an interposing flap with very little difficulty. In the second place, you can open the joint with little or no difficulty by a U-shaped skin and fascia incision base upward, the limbs of the U passing about one inch to either side of the greater trochanter and extending about two inches above and below. The trochanter major is then cut off from the femur with a Gigli saw, leaving all the muscles attached to the trochanter and undisturbed. This trochanteric fragment is then displaced upward; thus allowing of free access to the joint. By means of a chisel the ankylosis is broken up. The next step

is to restore the normal anatomic conformation of the head of the femur and the acetabular cavity.

We formerly made a new cavity with a chisel, but now we have a special instrument, an end-mill and reamer, with which we can restore the normal anatomy of the joint exactly both as to size and shape. We can do this in a few minutes. With the reamer, which is globular in shape, we restore the acetabulum, and with the end-mill, a cup-shaped instrument which fits over the head of the femur, we round it accurately so as to secure a perfect fit. These are the only two special instruments we have in connection with this work. Next we interpose the fascia lata flap between the head of the femur and the acetabulum and attach it to the margins of the acetabulum with phosphor-bronze wire sutures. The capsule is likewise tucked into the acetabulum. The trochanter is nailed back in place and then the wound is closed with deep catgut and superficial horse-hair sutures in the usual manner. No drain. The wound is sealed with collodion gauze and over this a large dressing is applied.

The leg is placed at rest in a travois splint. Passive motion is begun in a week or ten days.

A very distressing case of this type of affection was that of a man who had a bony ankylosis of both hips. He was ankylosed up to his second cervical vertebra. He could not sit up. They had to swing him out of bed. He could not walk. He was useless to himself and a burden on the community. We operated on both hips, at different times. He now has splendid motion in both hips, and for the first time in eleven years is able to sit in a chair. A woman had an ankylosis of the hip following pregnancy. On the eleventh day after a miscarriage, she had a chill, followed by infection of the joint. A joint infection is uniform in its manifestations. The

ankylosis was on the inner side at the inlet and outlet of her pelvis. We did the usual plastic operation. Normal motion is restored.

My first case was done in 1902. I demonstrated this case at Seattle (the patient lived in the neighborhood of Seattle) where I delivered an address on this subject. One would hardly know that this patient had anything done with his hip joint—other than that the limb is shorter than the other, because the osteogenetic layer of the epiphyseal line was destroyed by a bullet wound when he was eight years of age. Now, he is able to ride horseback from eight to ten hours a day.

The next subject I wish to take up in connection with this work is the regeneration of bone and the conditions under which bone is made. In the regeneration of bone I shall mention a few conditions in connection with injuries of the shoulder-joint, injuries to the hip, and injuries to elbow-joint. The elbow-joint gets the doctor into more trouble than any other joint. The wrist-joint gives the most frequent deformity; and the ankle-joint comes next in frequency of deformity.

We had a case of fracture in the neighborhood of the elbow-joint, with backward displacement of the entire articular surface. The lower end of the upper fragment impinged against the coronoid process of the ulna when the patient tried to flex his arm. I mention this in connection with the regeneration of bone to accentuate this fact, that when you are operating on this class of cases you must permit the periosteum of that portion of the bone to remain on the bone and be removed with the bone. If you permit the periosteum to remain in connection with the muscles, the biceps and its connective tissue, that will all fill up again with bone between the two points. That has been demonstrated experimentally by Owen

and by clinical experience again and again. Therefore, in the management of that case, what one desires to do is to refracture the bone, remove the periosteum by a lateral incision, displace the cartilage, and cut that portion out with a chisel.

I want to mention two cases, one of which almost led me to make an error in diagnosis. The man had put on his clothes, after having been examined, and was about to leave the office. Briefly, the history of the case is this: While riding on his bicycle he was thrown on his side, striking on his head and ankle. He remounted, went home, and continued at his work for four weeks after the accident. He had no pain in his hip.

He came into my office two weeks later, but previous to his coming another patient had been in my office who had the same kind of injury two and a half years previously. It looked to me exactly like a case of acute round-cell sarcoma, and I concluded it was an acute round-cell sarcoma and so informed the patient. As soon as he began to walk out of the office I said, "Why do you limp so much? Does it pain you?" He replied, "No, doctor, I have never had any pain from the time my hip was hurt."

That was the cue. He never had any pain from the time the hip was hurt, meaning what? Meaning that he had tabes, and that he had a tabetic joint. As a result of his fracture he had a Charcot joint developing after syphilis. It was not a sarcoma at all. He had no other evidences of tabes. His gait was not that of a locomotor ataxia. He had no Argyll-Robertson pupil; he had no changes in sensation, and no Romberg sign.

I sent him to the pathologist for examination, and the pathologist reported that he had a Wassermann reaction strongly positive. He said, "This man must be in the second eruption of his secondary syphilis," be-

cause he was in such an active stage at the time. I sent him to another pathologist, with the result that the same report was made, namely, a Wassermann reaction, strongly positive.

I operated on him. It was a case of typical Charcot joint. It was not a sarcoma at all, but we came near making an error in diagnosis.

Within a week after that in came another man. He came in for advice concerning a deformity of his foot. He felt he had been badly treated. He had a Pott's fracture, and he thought the doctor who treated him should compensate him for the bad treatment.

To look at the foot you would say it was a bad result following a Pott's fracture, but it was not a bad result. There was an inversion of the foot, whereas a bad result in a Pott's fracture always gives an eversion of the foot. That was point number one.

Point number two was that there was an enormous deposit of bone in the neighborhood. I had only been practicing a few months when I encountered one of these cases. I examined the man carefully and took account of the deformity in his ankle. This patient had all of the symptoms of tabes except the locomotor ataxia. He had no irregularity in his gait other than the limp from his deformity. The skiagram showed enormous deposits of bone around the joint, which is merely a Charcot joint following a fracture.

The next class of cases to which we wish to call your attention are those in connection with the reproduction of bone and the conditions that tend to it. First, in regard to fractures of the hip. Why have we failures of union in fractures of the hip in young people? We have had many failures of union in fractures in old people which we have attributed to the absence of osteogenetic elements in the distal por-

tions, but why do we have failure of union in fractures in young people?

In a fracture of the femur, the capsule of the joint was torn from its attachment around the trochanter major, and when the bone came back, the capsule folded in between the two fragments. The skiagram shows that very well. We made a careful dissection of that joint, taking the capsule from its new position between the fragments, and putting it into its normal position. We nailed the fragments together and the joint was completely restored, both with regard to function and anatomic result.

I have had four of these cases in my practice since last August, showing how frequently this fracture occurs.

The deposit of bone in the capsule in one case was four-fifths of the distance between the head and the neck of the femur. There was a splinter of bone locked there by the enormous deposit of bone in these cases, the same as in the Charcot case, but that was just an excess of bone produced by nature in her efforts to get union across that line where the capsule was interposed between the head and neck of the bone.

That brings us to the consideration of the regeneration of bone. What are the conditions in which we desire regeneration of bone?

1. In deformities of the face, particularly in the deformities of the nose, where we wish to implant beneath the skin bone that will live, and regenerate in the same size and shape that you transplant it.

2. Where you have non-union of fractures, and I have some beautiful specimens showing non-union of fractures with the Lane plate in and splendid apposition, but not the slightest effort on the part of nature at bone reproduction, which is exactly in consonance

with our experience where we have found non-union so often in connection with fractures at the junction of the upper one-quarter with the lower three-quarters of the humerus, at the junction of the lower third and upper two-thirds of the tibia, which are the most common positions for non-union.

3. Where we have a dead portion of bone, as the head of the femur or the head of the humerus, separated from its attachments, the result of fracture.

4. Where we wish to remove a neoplasm involving bone and retain the extremity in its normal conformation.

5. Where we have necrosis of bone resulting in an enormous defect of the bony structures.

Those are the five conditions in which we desire the reproduction of bone.

In order to have a bone transplant survive, it is necessary that certain definite and accurate conditions be fulfilled:

1. That the field be kept aseptic.

2. That the transplant be put in contact with osteogenetic living bone, with no interposition of any foreign substance or tissue.

If that is done, whether the contact is of one end or the other, regardless of the length of bone-tissue to be put in, the transplant will fill with bone of exactly the same shape as the original bone, and it will attain as large a size as necessary to support the weight that is placed upon it.

Those are the elemental things that must be borne in mind in bone transplantation.

A case illustrating the death of the head of the femur, is that of a boy who fell down an elevator-shaft. We saw him seven weeks after the accident. The head of the femur was rotated. The fractured portion of the head was locked in the capsule and had

strangulated the ligamentum teres to such an extent that when we looked at the picture we felt there was nothing to do but to cut down on the joint and bring the parts in contact with nails. When we found the head it was black and necrotic. It had been dead for seven weeks. To attempt to take out the head would have meant to incapacitate the boy permanently. We rotated the head just as though it had been living all the time, reasoning that if we put that framework in contact with osteogenetic elements, the Haversian vessels would carry with them osteoblasts, and they would fill all of that dead portion of bone, and a new bone, of exactly the same size and shape as the old, would be reproduced. The transplant always dies. It is removed in molecules. It acts merely as a carrier for the Haversian vessels which take with them the osteoblasts and reproduce bone.

Three years after the operation the nails are still in position. The bone has all regenerated, but a little necrosis occurred, and a little absorption of the under side. The patient is at his usual occupation. Flexion and extension are normal. There is about one-third of an inch of shortening.

The next phase of our work is illustrated in the shoulder-joint. A young woman sustained a fracture at the anatomic neck of the humerus with luxation of the head. We hoped to swing the head around into the glenoid cavity some months after the accident and still have some attachment left.

We exposed the joint, took out the head of the humerus, freshened the surfaces of both fragments, replaced the head in the glenoid cavity and nailed the fragments together. Primary union took place with complete regeneration of the head of the humerus. Function has been restored almost entirely.

The next phase of the subject we shall take up is the manner of treating ununited fractures. Here is

an illustration of a case in which the fracture was wired. There is splendid apposition. Separation took place, but there was not the slightest effort at the reproduction of bone. This is commonly the case. I exposed the parts, and freshened the ends of the fragments preparatory to implanting the transplant. We always take out a piece of compact bony tissue from the patient's tibia and implant it into the medulla of the upper and lower fragments and secure it there with nails. We always take the implant from the same patient, from the tibia. In that way we have a very positive means for the reproduction of bone and the establishment of union.

Another case that involves a different principle, is that of a man who had a very bad fracture of the pelvis. The head of the femur was completely separated from the neck. We had no head to put on. I detached four-fifths of his trochanter beneath the muscular attachments, swung it around, freshened the neck, and nailed the fragment of trochanter on to the femur to give him a new head for his femur. The fragment of trochanter to which the muscles were attached was nailed back in place. The femoral head was regenerated and the patient has perfect restoration of function, and hardly any shortening.

The next line of thought concerns the reproduction of bone where it has been destroyed by inflammatory conditions, and the following is an illustration of a case in which the tibia was destroyed. The patient was a little girl eight years old. The shaft of the tibia was almost completely destroyed by an osteomyelitis. The necrotic bone was removed. The fibula was implanted to the epiphyseal line of the tibia. I removed the bone only from the epiphyseal line of the tibia, taking off the epiphyseal line of the tibia, otherwise there would be a double growth in the fibula. Then we waited until the wound had entirely healed before

doing the transplantation. After about three months we took a piece of bone from the opposite tibia, five-eighths by one-half by three-eighths by five-eighths, and merely contacted it with two spiculæ of bone, one above and one below, neither of them larger than the end of a lead pencil, and still they supplied that all-important essential of carrying in here osteogenetic elements. Complete restoration of the tibia took place. There is now no deformity and no shortening. The girl stands squarely and firmly on both feet.

The next element of reproduction of bone is where the bone has to be excised. A patient sustained an accident to his hip two and a half years previously. A permanent swelling began to appear. The neoplasm was of slow growth. We thought it was a giant-cell or spindle-cell sarcoma. If it were either of these growths we felt that we could excise the upper end of the femur, take out the diseased tissue, and make a new femur, using a portion of his tibia. We removed the upper end of the femur, including the head, and implanted a piece of bone taken from the patient's tibia. The upper end of the fragment was placed in the acetabulum, the lower end into the medulla of the femoral shaft, being held there by a nail. Although the patient was over forty years old, complete regeneration of the upper end of the femur took place with a return of normal function in the joint.

I have a skiagram showing a fetus *in utero*. The patient came to me to find out whether there was a tumor present with the fetus or not.

The skiagram was made by Dr. P. S. O'Donnell, of Chicago. It is striking. When the patient came for examination, September 1, 1911, I recognized a sharp projection in the left hypochondrium, which I interpreted as the hand or foot extending far in front of the occiput. That was a striking feature. This object was pressing up on the left side and could not be

pressed closer to the head. The rest of the fetus was easily outlined and the case diagnosed as one of pregnancy, although the woman believed she had passed beyond the usual time for delivery. The wall of the uterus was so thin that it was questionable as to whether it was an abdominal pregnancy or not; it did not contract on manipulation.

The question arose, why was the hand held in that position, and particularly the right hand? In this skiagram the bones are clearly outlined. The right hand is held rigidly in that position because there is a bony ankylosis of the elbow. Delivery occurred six weeks later. The labor was of short duration; it was a breech presentation. The child came unaided. The arms were extended above the head as the fetus passed through the lower strait. No effort was made to draw them down. The cord was twisted around the neck, but it was not noted whether it included the arms or not. The child suffered but little cyanosis. It was noted by Dr. Fredericks, the accoucheur, that both arms were paralyzed and that there were annular depressions, just below the axilla, showing the existence of previous constrictions of both arms.

I was in Joliet the following day and made a somewhat hurried examination of the child. The arms rested close to the baby's side, were motionless and all the muscles were atrophied, on the right side more than on the left, the latter being twice the size of the former. There was a complete absence of cutaneous or muscle reflex in the muscles of the arms and shoulders, and a flaccid paralysis, showing that the lesion was in the lower motor neurons and not of cerebral origin. The strangulation was not due to amniotic bands around the arms as the deltoids were involved, which could not be caused by these bands on the arms. There was an annular depression in the neck just

A NEW APPARATUS FOR THE REDUCTION OF FRACTURES OF THE LOWER EXTREMITY

CHARLES H. LEMON, M. D.

MILWAUKEE, WISCONSIN

Tradition is responsible for many of the great errors that men generally fall into. To tradition we must attribute the general belief that intracapsular fracture of the femoral neck is incapable of bony repair. A great surgeon, the disciple of a greater master, by the use of the appliances of his day, was unable to immobilize and approximate the fragments in fractures of the femoral neck. He was also unable to immobilize and approximate the fragments in other fractures of the femur; but, because his theory, which was and still is sound anatomically, was disputed, we find him, during the forty years of his active career, exploiting it and impressing his belief upon his contemporaries, so that nearly all else concerning him has been forgotten, and succeeding generations, without attempting to analyze the facts which were the basis of his reasoning, have accepted his statement as a matter of tradition.

A review of the writings of Sir Astley Cooper, for the purpose of endeavoring to understand his theory, brought me to the unexpected description of an apparatus for making extension of the leg. For obvious reasons this apparatus was unsuitable in the treatment of fractures of the femoral neck. He devised it for the treatment of supracondylar fractures, an accident which, his experience has shown, re-

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sulted nearly always in hopeless deformity. His apparatus was primitive, but it embodied the essential factors of extension and counter-extension.

Before we state that Sir Astley Cooper was grossly mistaken in his forty-years oft-repeated statement that intracapsular fracture of the femoral neck was incapable of bony repair, let us understand what the reason was for this statement. In fractures of the long bones elsewhere the pull of the muscles approximated some portion of the fractured bones, and where this approximation took place bony union occurred. The incidental matter of the over-riding of the fragments was of no consequence.

Within the capsule of the hip-joint there was no possibility of approximation, because the fractured ends were separated by the action of the muscles attached to the upper end of the femur, and the distal portion of the neck was pulled in a direction at right angles to the neck. There was therefore neither approximation of the fragments nor pressure.

What effect the synovial fluid exerted in preventing union was a matter of conjecture. In Cooper's mind there was but one dominating conviction, as shown by his experimental work on animals and his dissections of those having fractures who died from other causes, and that conviction was, without pressure there is no union. In every fracture of the shaft of the femur, at some time or other in his treatment, he used a circular cuff of leather to effect pressure between the fragments. He used this lateral pressure because it is certain that he never was able to fully extend the fragments and effect end-to-end approximation. It remained for Mr. Lane to show us the necessity of the end-to-end approximation, if we would restore physiological function.

Materials and means unknown to Cooper, have offered, in our day, a solution of his difficulty, and today

no well-informed surgeon believes for a moment that any intracapsular fracture is incapable of bony union. This knowledge, unfortunately, is not generally shared by the great body of physicians.

After nearly a century another distinguished anatomist and surgeon has attracted the attention of the surgical world to Guy's, and by exact technic and sound logic has stimulated the surgical world to new efforts to place the treatment of fractures upon the same exacting plane that other fields of surgery have enjoyed during the past two decades. Yet by a curious coincidence Sir Astley Cooper and Mr. Lane each failed to solve the problem of bony repair in intracapsular fractures of the cervix femoris.

Is not the reason why we have made such slow progress in the solution of the fracture problem, that we have forgotten the antomical teachings of the former and disregarded the surgical technic of the latter?

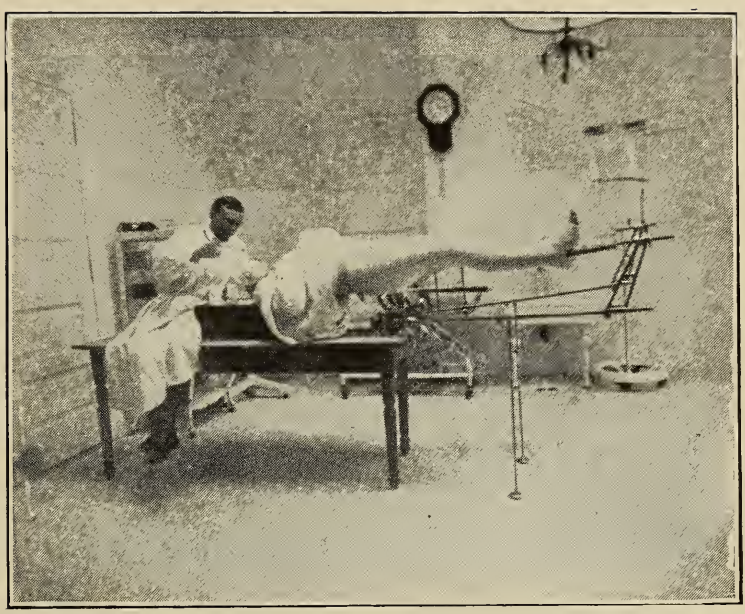
The whole idea embodied in the new extension-apparatus here shown is to make possible the restoration, by definite mechanical means, of the normal planes of the long bones by placing the fragments in apposition. According to Cooper it was to exert pressure, without which union is impossible; and according to Lane, to restore the normal physiological planes and avoid the formation of provisional callus. How strange to our ears the statement of Mr. Lane sounds, that callus is an evidence of bungling on the part of the surgeon, yet the statement is true. One is almost startled in examining *x*-ray plates of fractures completely reduced, with or without the use of Lane plates, to note in every case, whether taken weeks or months afterwards, an entire absence of provisional callus. We have known for years that no callus formed in linear subperiosteal fractures, but the thought has been slow of development, that linear fractures, like linear wounds of the soft parts accurately approxi-

mated, need no callus, the bony equivalent of scar-tissue, for scar-tissue it is.

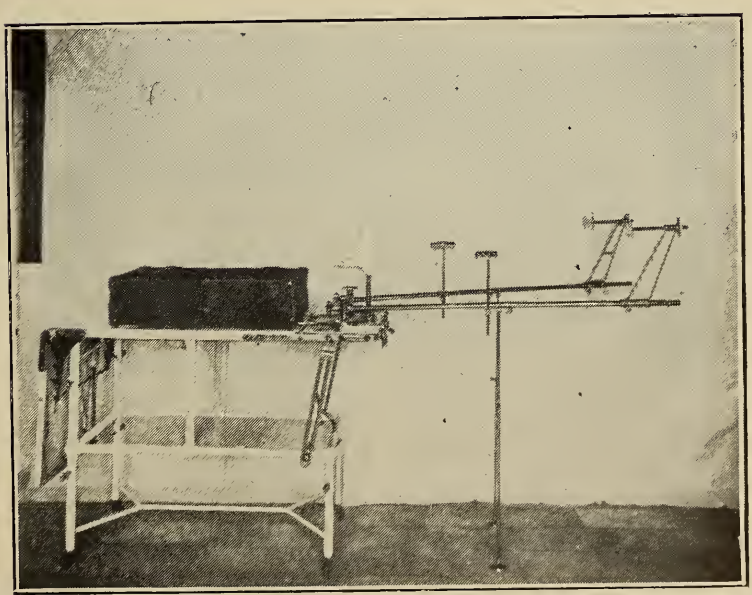
The factor A, pressure, and the factor B, approximation of fragments, we have learned are essential. We have been beguiled these many years by the phrase "good functional result." Is it not true that any result which did not terminate in a malpractice suit or an amputation was, by poetic license, called a good functional result? What we need is restoration of distorted anatomy. When we restore anatomy, we restore function, and in no other way.

No extension-apparatus can be generally used without the use of either plaster-of-Paris or the Lane plates for maintaining the extension after the apparatus is withdrawn. We have these two means at hand: one for use in the treatment of ordinary uncomplicated closed fractures, the plaster cast; the other, the Lane plate, for use when, because of the interposition of the soft parts, the approximation of the fragments is impossible without open incision and removal of the interposed bodies, whether muscle or fragments of bone.

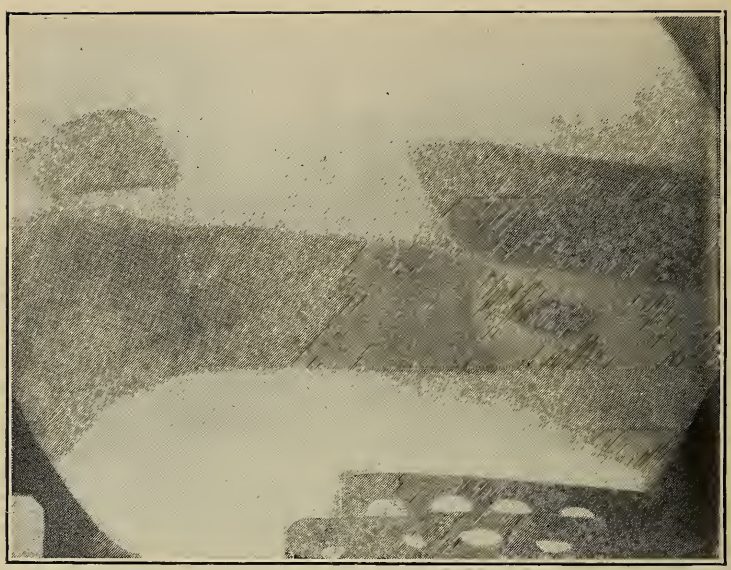
By the use of mechanical extension either problem may be dealt with successfully in one or two stages. In the simple fracture, as well as in the compound one, the extension can be made first, the limb being encased in plaster after full extension by the apparatus is made. There is no danger of over-extension, as my experience has abundantly demonstrated, because the extension is always limited by the inelastic fascia overlying the muscles, and there is always a slight retraction of the fragments when the apparatus is withdrawn and the leg adapts itself to the encircling plaster cast. If, after the cast has dried, the *x*-ray shows insufficiency of approximation of the fragments, a fenestrum can be cut in the cast sufficiently large to permit open invasion of the seat of the fracture, and



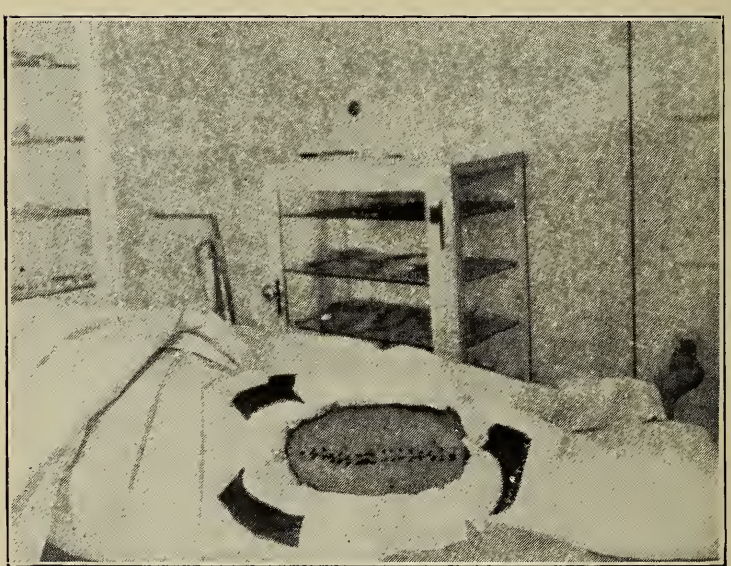
1. Plastic spica for fracture at the lower end of the femur.



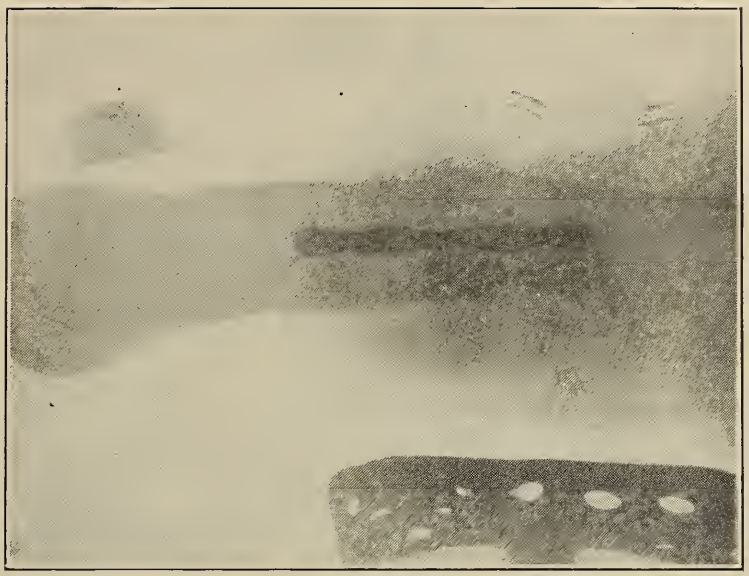
The Lemon extension.



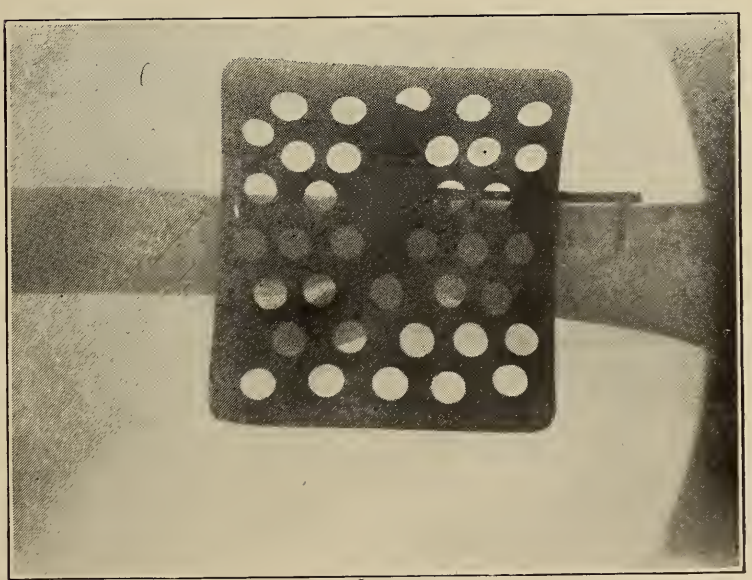
2. Skiogram through the cast.



3. Lane plates applied through a fenestrum in the cast.



4. Skiagram after operation. Lateral view.



5. Skiagram after operation. View from above downwards.

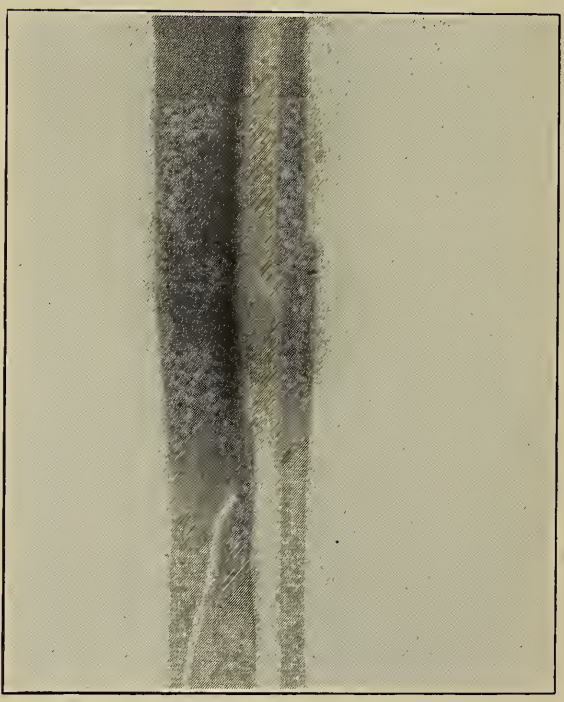
Skiagram through cast after reduction by the Lemon extension.

Lateral view.

Lateral view.

Skiagram through cast after reduction by the Lemon extension.

Lateral view.

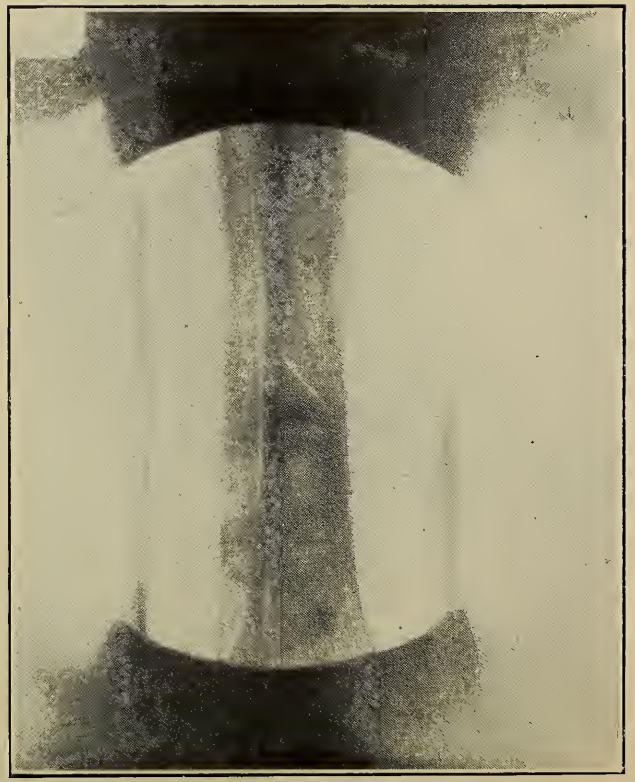


Skiagram through the cast after reduction by the Lemon extension.

Fracture of the femoral neck eight weeks after injury. Three inches of shortening.

Reduction by the Lemon extension after Royal Whitman. Fixation by wire nail.

Skiagram through cast after reduction by the Lemon extension.



Lateral view.

we have an easy and safe access. With the Lane instruments the ends of the bones are easily freed from interposed material, and approximated, without great strain, with little disturbance of the periosteum, with little hemorrhage, and with no shock.

The question has been asked, what effect has this extension, made through the foot, upon the ligaments of the knee-joint? The answer is, in an experience of three hundred cases during the past five years it has not caused the slightest inconvenience and no injury. The acrobats who turn aerial somersaults and are caught in the air by the feet in an inverted position, experience daily the sudden tension of the knee-ligaments, caused by the entire weight being suddenly thrown upon them, without injury. Why, then, should we fear the application of mechanical force upon these ligaments when, in applying this force but once by the use of a small screw, we can feel the arrest of pull when the fascia covering the muscle has been made tense.

In only two instances have any unpleasant symptoms developed in consequence of the pressure which is exerted against the pubic arch. In these cases there was a temporary loss of sensation in the skin of the scrotum. In one case a man was brought to my operating-room with a fracture of the lower third of the leg, and without removing his trousers, simply ripping up the trouser-leg on the injured side, and without an anesthetic, mechanical extension was made and a cast applied, and the man went home with the aid of a pair of crutches. It is probable that in this case the seam of the trouser-leg may have caused undue pressure. In the second case a heavy, continued pull was made on a fracture six weeks old with overlapping, in which subsequently a Lane plate was applied through a fenestrum in the cast.

No claim is made that this instrument is automatic or a miracle-worker. It is an instrument of precision, and when intelligently used much can be accomplished. That it will enable surgeons to obtain better results than was possible by the Buck's extension, is my experience after five years of personal use. It has made unnecessary the general operation of closed, as well as many compound, fractures by enabling the surgeon, at his leisure and without the aid of assistants, to completely extend fractures. By its use it is my hope that more definite apposition of fragments in all parts of the leg will be made possible, because the rods which carry the foot-piece, from which the extension is made, can be placed in any position the human leg can be. It has overcome the difficulty recognized by Sir Astley Cooper and the limitation of Mr. Lane's plates in intracapsular fractures of the femoral neck. If we study the beautiful work of a distinguished New York surgeon, Dr. Royal Whitman, we shall learn that in fractures of the femoral neck, by abducting the leg to an angle approximately of forty-five degrees, causing tension upon the under portion of the capsule, the two fragments are directed towards each other, the upper border of the great trochanter and the neck being brought in contact with the rim of the acetabulum; and with extension and fixation of the leg in this position by the Lorenz plaster spica, bony union can be almost assured in every case.

It is my opinion that no more beneficial procedure has been suggested in the whole literature of fractures. Dr. Whitman has brought hope and relief to thousands who have heretofore been condemned to invalidism because of tradition or because a great anatomist and surgeon nearly a hundred years ago was unable to get off a hobby-horse.

That this instrument may prove in the hands of others the valuable adjunct it has proven to myself

in the treatment of fractures of the lower extremity, is my reason for exhibiting it at this meeting.

DISCUSSION

Dr. Willard Bartlett (St. Louis, Mo.): Recently, it has been impressed upon me that the use of some mechanical means of exerting traction instead of manual means, which we formerly employed, is to be recommended, at least in the open treatment of fractures. I have had no experience with the mechanical tractor other than in open work, but its benefits, which I think are many, stand out prominently and can be sharply contrasted with the pull, or push, or what-not, that the assistant gives. This is especially true if the injured member is a thigh. It so happened on another occasion I had traced up eighty open operations for fracture, the earlier half or perhaps three-quarters of which were done without any mechanical aids of any kind other than the ordinary surgical armamentarium. The last fourth or third were done with a mechanical tractor different from what you see, but the principle of which is about the same, and I have found in this last fourth or some such number that the operation has been greatly facilitated by the use of something which has a pull on it that does not vary, as is the case with the pull that is exerted by an assistant who grows tired as he pulls and thus lets things slip. I believe that one will greatly facilitate the open operation if he will exert more than the degree of traction necessary to really bring the fragments into place. What I have done has been to pull on the foot with a mechanical tractor until so many pounds have been exerted between the fractured fragments. To make the approximation I desire, that is, just as it was before the break occurred, it is customary to take a sharp instrument or brush and clean out every bit of clot or granulation tissue in the spiculæ, in between them, and then by removing the tractive effort and giving a blow on the heel you absolutely drive the fragments together, if it is anything like a square break, so that they stick pretty well before the Lane plate is applied or some other mechanical device is used.

Dr. Lemon referred to two or three points which I listened to with considerable pleasure, as they have been useful in my own hands, and I heartily recommend them. One is applying a plaster spica to the thigh. It is an advantage, in most instances, to include for a short distance the thigh of the opposite side. This may seem trite to most of you, but I will say I

have usually, as in the other thigh, left out the plaster and was sure the result might have been improved if it had been included.

Another thing which I believe should not go without mentioning is his reference to the work of Royal Whitman, of New York. Dr. Whitman in his original article, when it first appeared, called attention to a certain procedure, and I believe for intracapsular fractures of the thigh it is certainly, in most instances, a very useful one.

Now, about mechanical appliances like this, it seems to me it is to be looked at in two ways. In the first place, does it work well in the hands of the other practitioner? Frequently an appliance does, but it is so difficult to understand that nobody else can make it work. I have no doubt that it works well in the hands of Dr. Lemon, and I hope it will work equally well in the hands of all of us, but this is always a matter of question until you have tried the other man's appliance. The general principle, however, that underlies the appliance appeals to me. Lots of work can be done with a mechanical tractor, in that it will control the rotation of the lower fragments, but this can be done by assistants pulling behind.

Dr. Lemon did not tell us anything about his choice as to open and closed operations for fractures in general, and I do not believe general rules can be laid down, as it is largely a matter of the individual case and of the experience of the operator, but I think I am safe in saying that the future of the open operation is going to be a good deal wider than the past has been, if proper conservatism is applied.

Dr. James E. Moore (Minneapolis): A few years ago, when this society met in Denver, Dr. Ruth was on the program for a paper on fractures of the neck of the femur. Two or three of the doctors at that meeting said, "Let us go down stairs," as they thought this paper would not interest them very much. I went downstairs with them, but was not gone very long. I returned, and Dr. Ruth was still talking. I saw the beautiful specimens that he exhibited there, and there was the indisputable evidence that he had secured, time and again, bony union in fractures of the neck of the femur, which I thought was impossible. I was immediately converted when this indisputable evidence was furnished. I went home and introduced this method of treatment of fractures, the Maxwell method, and it was generally accepted by the surgeons. The point I wish to make here is that the general practitioners who see the majority of these fractures, feel that it is not

possible to get bony union in a case of fracture of the neck of the femur. They do not get union because they put on the old time Buck's extension, which is the greatest humbug ever perpetrated, but the surgeons in Minneapolis do get bony union in fractures of the neck of the femur.

I feel under obligations to Dr. Lemon for offering this mechanical device. It appeals to me because it is rational and helpful. I have been looking for such a device to introduce into the University Hospital by which we could make this mechanical extension, because, as was mentioned by Dr. Bartlett, extension by means of manual pull is unreliable and uncertain. It is not the same all the time, and it is not always true, the puller gets tired and rotates the fragments without realizing it. Here, with this device, the pull is steady and sure, and I am confident it is a splendid thing; and fortunately it is applicable to those cases in which you do the open operation and to others. You can rig it up in any hospital and make use of it. I believe it is very efficient.

There is this one thing I must protest against, and that is the old excuse, first mentioned by Astley Cooper and others, that fractures of the neck of the femur would not unite simply because nature failed. I tell you, we must insist upon it, that when we do not get union in a fracture of the neck of the femur it is our fault, and not the fault of nature. If we bring the fragments in apposition and hold them there, they will unite. They have united for me every time since I have applied the Maxwell method.

The last case I had was of special interest, in that the patient was a doctor's wife, sixty-three years of age, who had had a fracture of the neck of the femur, and it had been unrecognized for a month because she had internal rotation of the femur, instead of external. When I saw the case, a month after the fracture had occurred, it was easy to make a diagnosis; she had been lying in bed with Buck's extension on; there was no apposition of the fragments; I put the limb in a Maxwell dressing, and today she is walking with firm bony union. I got hold of the case a month after the fracture had occurred.

One other point: I have recently operated with most gratifying results upon some of the old neglected cases of fracture of the neck of the femur. I have used Jones' method of sawing off the trochanter and turning it up, getting beautiful access to the joint. It is right before you. You can get the fragments in absolute apposition, freshen the surfaces, nail

them together with two nails to prevent rotation, sew up the capsule, put the trochanter back, fasten it with one nail, and you get beautiful results.

I received a report from my assistant yesterday concerning the case of a man on whom I operated six weeks ago. He had been lying in the almshouse in Duluth for two and a half years because he had a fracture of the neck of the femur. He had been treated; Buck's extension had been applied, but there was non-union. He was brought to the University Hospital; we opened the limb up after the Jones method, brought the fragments into apposition, and when the assistant took the apparatus off the patient had good motion without pain. The assistant was positive there was firm bony union. We must promise these patients bony union. If we get hold of these cases early, bring the fragments into apposition and maintain them there, we can promise these patients bony union. There is no reason why a fracture of the neck of the femur should not unite as well as a fracture of the shaft. If the Maxwell method is followed, union will occur in a large percentage of the cases in fracture of the neck of the femur as well as in fracture of the shaft.

Dr. M. L. Harris (Chicago): Having had considerable experience in the use of this apparatus, I wish to say some commendatory words concerning it. I have come to look upon the use of this device as an essential factor in the successful treatment of a large percentage of cases of fractures of the lower extremity. In all cases in which there is a displacement I look upon this apparatus or a similar one as the most satisfactory method in bringing about a proper reduction of the fragments, not only in those cases which we are going to treat without operation, but in practically all cases in which the open method is to be carried out. The essential factor in the successful treatment of fractures by the open method is having proper appliances to work with. It is absolutely necessary that we avoid all unnecessary manipulation of the fragments, and this apparatus permits us to operate on these cases with the least possible manipulation of the fragments. The patient is placed in the apparatus, extension is applied, after the wound is opened, until the fragments are drawn into accurate position, where a plate can be applied with almost no manipulation of the fragments. My experience has shown that there are certain little defects in this apparatus which are very easily corrected. First, with a heavy man and an old case, with overlapping of the femur, so much tension is necessary to put on

the leg that the tendency is for the apparatus to buckle up in this way (indicating); consequently, I have fixed a support from the end here to the lower end of the table which prevents that. The second is, with a heavy patient, the tendency is for it to wobble this way (indicating), or to turn. It requires an assistant constantly holding these supports. A support between the ends here which can be lengthened overcomes that difficulty. This joint can be improved upon. The tendency is for this to turn on the shaft; it has to be held; I cannot tighten it so that it won't turn. I have found that a great trouble in connection with this apparatus. You must be very careful to properly pad this apparatus if you do not wish to hurt the patient. It requires a great deal of extension to overcome the overlapping in old fractures. Next is the proper application of padding to the foot. If you do not do that, you may get sloughing. You must be careful if you put the patient in the apparatus and are going to apply screw extension, which you know is very powerful, to see that there is proper protection to the soft parts.

As I have said, I think this apparatus is absolutely essential to the successful treatment of fractures of the lower extremity. We must have better results with fractures. People are becoming familiar with the *x*-ray pictures and they know what a good result is in fractures. They are demanding better results in cases of fractures. I am very much in favor of the apparatus and in favor of the open treatment of fractures.

Dr. D. S. Fairchild (Clinton, Iowa): I want to bear testimony to what these gentlemen have said in regard to the necessity of using an extension apparatus in cases of fracture of the thigh where it becomes necessary to treat by the open method and for the purpose of applying a plaster dressing. We have used for a number of years an apparatus which is known as the Ridlon extension apparatus, which has served us a very good purpose.

Now what Dr. Bartlett has said is of very great importance in making extension a little more than would be necessary to make the same length, in order to push the ends together, especially in cases where the fracture is nearly transverse; but in the very oblique cases, where we need to bring the leg out with a good deal of force and maintain it there steadily, there is nothing apparently that can take the place of an extension apparatus similar to this kind.

Dr. Lemon (closing the discussion): I am very much pleased with the general discussion of my paper this morning.

In endeavoring to develop something that would be of assistance to me in my own work, five years ago Dr. Miller, of Chicago, and I devised the first extension apparatus for the treatment of fractures of the lower extremity. I had one made for Dr. Hessert and I am very glad to know that Dr. Harris has been using this apparatus. The criticism he has made of its defects I have also noticed. The apparatus is not designed to be used in fractures of the upper extremity.

Any apparatus has to be used a number of times before one becomes familiar with it and it is quite possible that those using it may be able to broaden the scope of its usefulness.

As to the choice of the open or closed method of treating fractures I have none. I do not take an *x*-ray of a fracture as a rule before attempting to reduce it. It would seem that in our day the reduction of fractures is a lost art and we have lost the art chiefly because we have fallen into the habit of relying upon the findings of the *x*-ray laboratory.

I always attempt to reduce a simple fracture by making extension with the apparatus first, doing the best I can according to my conception of what the line of fracture is. I then have an *x*-ray made, and if this is unsatisfactory from the anatomical standpoint, I operate on the case by making a fenestrum through the cast. It is simple and efficient. Free access can be had to the parts and the operation is followed by little or no shock and practically no difficulty. In recent cases I can always depend upon getting full extension of the fracture. In treating old un-united fractures or those which have united with over-riding it is necessary to make the reduction first. You put the patient on the apparatus, make the mechanical extension and, after incision over the fracture and with Mr. Lane's instruments, approximate the fragments. The leg is held perfectly rigid. One can operate without the slightest difficulty. There is no twisting or manipulation and there is no contact by the hands with the wound or with that portion of the instruments that is used in the wound.

Since I saw Mr. Lane do his work last spring I have not had to remove any of his plates excepting in one case where I had infection of the wound from non-sterile catgut. In all the other cases the plates are still on the bones and this I believe is due to the fact that in operating with the aid of this apparatus there is but little general manipulation of the wound.

At the surgical congress in Philadelphia, I was surprised to see a number of operators, who, in putting on Lane plates,

did not carry out in a single instance the technic of Mr. Lane. I have no doubt that infection followed in many of the cases that I saw in which the Lane plate was used, and that these plates will have to be removed.

I appreciate the criticism of Dr. Harris and Dr. Moore, especially that of Dr. Harris, because he has had personal experience with the apparatus. I did not know that he had been using it. In our hospital some five surgeons are using this apparatus and the results they are now getting are uniformly better than was possible by the use of the Buck's extension.

ARTIFICIAL TENDONS AND LIGAMENTS OF SILK IN THE SURGICAL TREATMENT OF THE PARALYSES

NATHANIEL ALLISON, M. D.

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The aim of surgical treatment where the relief of the effects of a paralysis is at stake, is either to furnish improvement in muscle-balance or to produce stability in the palsied member. The operations which are designed to restore muscle-equilibrium are *nerve-anastomosis* and *tendon transference.*

Of nerve-anastomosis it may be said that it is the most recently added surgical measure, and that it is the nearest to the ideal, aiming, as it does, at a complete re-establishment of muscle-balance. Though it is an operation which does not require exceptional surgical skill for its performance in general, it is, nevertheless, one that demands more than ordinary ability to choose the proper case for its employment. Comparatively few operators have had much experience with nerve-anastomosis, due to the uncertainty which exists regarding the outcome, this depending upon the regeneration of nervous tissue after the operation has been done.

Tendon-transference is an older and more thoroughly tested measure. The epoch started by Nicoladoni, when he sutured an active muscle-tendon to the tendon of an inactive one, has produced many important technical ideas. Before this period surgeons were content with deformity correction and braces. Though these two things are recognized as essential today,

they are regarded as steps, and not as all that should be done. The Nicoladonian tendon-graft passed through a thorough clinical trial, and its fundamental error has been recognized and corrected, so that in tendon-shifting today only its basis of power-transference is practiced. The class of cases which are suitable for tendon-transference includes only those that have strong functioning muscles, the power of which may be transferred to points of greater mechanical advantage. Lange, who has given us a large part of our present technic, says that for a successful result on a paralyzed foot he must have three healthy muscles at his disposal. One of these must be a plantar flexor, one must be a dorsal flexor and supinator, and the third a dorsal flexor and pronator after the operation, thus insuring muscle-balance. Failure to recognize the principle upon which this is based has led to many a disappointment after tendon-shifting has been done.

The operations designed to produce stability are *arthrodesis* and *artificial ligaments.*

For those cases that possess too little remaining power to justify either nerve plastic or tendon-shift, an operation must be done which will produce stiffness in the weakened or flopping articulations, one that will give the individual a stable prop to progress upon.

Arthrodesis has long been employed for this purpose. Though it is a justifiable operation in a small class of cases, it is recognized by most surgeons who have had experience with its results as being destructive and irrevocable. The plausible objections to it are that it is liable not to produce an improvement which will compensate for the damage done. Aiming, as it does, to destroy a joint, both functionally and anatomically, it implies adaptive changes throughout the entire limb involved. If done before well-established bony growth, ankylosis does not result. If, as

has been recently claimed, there is always some power of improvement in muscle-power in these cases, then the operation of joint-ablation may prevent the best ultimate result. Cogent as these reasons are for abandoning arthrodesis, there are nevertheless some conditions to which it is suited. These should be carefully selected, and in them the operation should be done as a last resort. To produce similar results, joint pegging and nailing has been resorted to, but the results have been unsatisfactory, the ivory pegs, or wire nails, having either broken off or worked out in most cases.

It is with the implantation of artificial tendons and ligaments that this paper is concerned, these operations giving the best chance of success in the cases that need an artificial stability established.

Auger, in 1875, reported the use of a piece of silk thread as an artificial tendon. In his operation he simply elongated a cut tendon with a silk strand and found that the silk healed in and that normal function returned. There then followed many experiments on animals and on man, which clearly showed that silk is a suitable material for this use, possessing sufficient tensile strength, and being capable of sterilization.

Lange has been the chief investigator in the surgical use of silk. To him we owe the elongation of tendons by silk cords in the paralyses, and also the technic of periosteal insertion. In 1903 he suggested the use of silk as artificial ligaments. The operation consisted in inserting under the skin, deep in the adipose tissue and near the joint capsule, seven or eight silk threads on each side of the ankle, attached above to the tibia and fibula, and below to the scaphoid and cuboid. This operation accomplished the checking of a drop foot at a right angle to the leg.

Ryerson has improved upon this operation by passing the silk cords, one on each side, up the sheaths of the tibialis anticus and peroneus tertius, respectively, the advantage gained being the insertion of the artificial ligaments under the annular ligament on the ankle.

Barton and Plummer have recently advised the placing of silk check-ligaments within the articulations, holes being drilled through the bones, and the joint surfaces being snugly apposed. This has been done at the ankle and knee, and seems to promise a reliable result.

In the consideration of silk implants in the tissues of man, the question arises as to the fate of the silk. Does it remain an inert foreign body within the organism? Do the tissues attempt to organize it, or is there from the start a tendency for the tissues to be rid of the implanted material?

There is an extensive literature on experiments done to answer these questions. Lange, after many operations and experiments, says that the silk is surrounded and penetrated by a very firm and thick connective tissue, which has thoroughly grown together with the silk, thus guaranteeing the durability of the artificial tendon or ligament, and showing us that we may cultivate connective tissue in places where we need it.

Sever has recently shown, in an excellent summary of the literature and by his own experiments, that the peritendineum is the important structure for proliferation of new tendon, and that silk may be used as a director for new tendinous growth, which new growth will penetrate and permeate the silk.

In order to possess silk that will be retained and that will act as a director of new fibrous growth in the tissues, it must be properly sterilized. To this end the observations of Lange are of interest. Lange

found that silk sterilized in pure water would become infected in the tissues after it had remained quiescent for considerable periods. He then proceeded to incorporate within the silk a stable amount of bichlorid of mercury. This was done by boiling the silk twenty minutes in one to one thousand bichlorid solution. He has also recommended paraffin coating the silk and draining the wounds for a few days after the operation. As his experience has been the greatest, his advice cannot be passed over lightly, but it has seemed to the writer and to several other observers that the paraffin step is unnecessary, and that the draining of wounds adds a danger of infection. It has been my custom to boil the silk shortly before operation in one to one thousand bichlorid solution and then use it directly. In no instance has it caused trouble. It seems wise to say, however, that operations of this nature call for a most careful surgical technic, both as regards cleanliness and the handling of tissues.

The operations here described are simple in character and are designed to produce stability about weakened or flail joints, without preventing a limited amount of joint-function. They also serve the important rôle of relieving over-stretched and weakened muscles from the force of gravity, or from antagonistic pull, this latter consideration being one of prime importance in certain forms of flaccid paralysis.

Operation 1.—Suspension of the anterior foot for paralysis of the anterior leg muscles, with foot-drop.

Through a small incision at the inner border of the foot the tibialis anticus tendon is exposed as it passes under the internal cuneiform, and the sheath of the tendon is opened. Through a similar small incision on the outer border of the foot the peroneus tertius tendon is exposed, and this sheath opened. A small drill with an eyelet at its end is now passed through

the anterior row of tarsal bones from one incision to the other. A silk cord is threaded into the eye of the drill and the drill is withdrawn. One end of the silk is now threaded into the eye at the end of a long flexible probe, and the other end of the silk is threaded into a similar probe. One of these probes is now passed upward in the sheath of the tibialis anticus tendon, and the other upward in the sheath of the peroneus tertius tendon. The ends of these probes may now be felt on the outer border of the tibia, above the middle of the anterior leg. Through a small, longitudinal incision made here the silk is unthreaded from the probes, and they are withdrawn. The foot is pulled up to the desired position of dorsal flexion, and the silk is sutured either to the tibial periosteum or to the bone itself. The wounds are closed, and a plaster dressing is applied. The latter dressing must relieve the tension of the silk cord.

Operation 2.—Heel suspension for paralysis of the calf muscles, with calcaneous position of the foot.

Through an incision made on the sole of the foot, over the os calcis, a small drill, with an eyelet at its end, is passed through the inner side of the os calcis upward, making its exit on the inner side of the tendo Achillis. This silk is threaded into the eyelet and the drill is withdrawn. A similar drill-hole is made from the outer side of the tendo Achillis through the os calcis and into the wound below, the silk is threaded into the eyelet of the drill, and the drill is withdrawn. This gives a loop of silk through the os calcis, the distance between the drill-holes being, at least, half an inch. From the upper inner incision a threaded probe is now passed upward in the leg, following the course of the tendo Achillis and then being directed anteriorly toward the anterior tibial surface. A similar threaded probe is passed from the outer incision up the course of the tendo Achillis and then forward

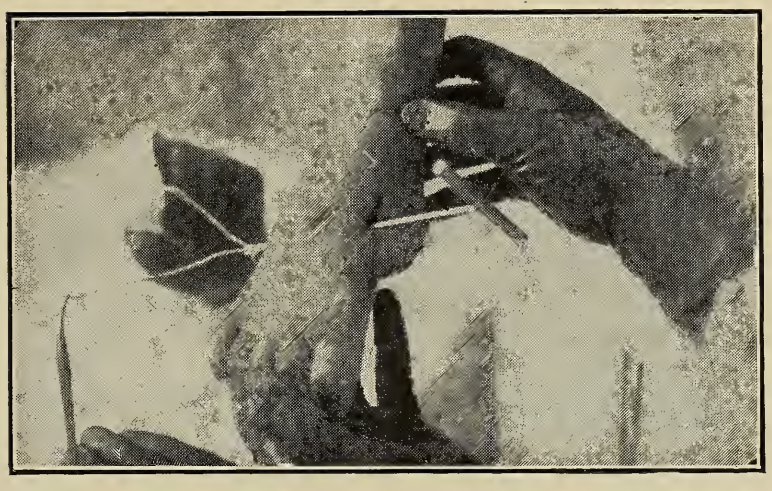


FIG. 1. The first step of operation: drawing the silk through a hole drilled through the tarsal bones.

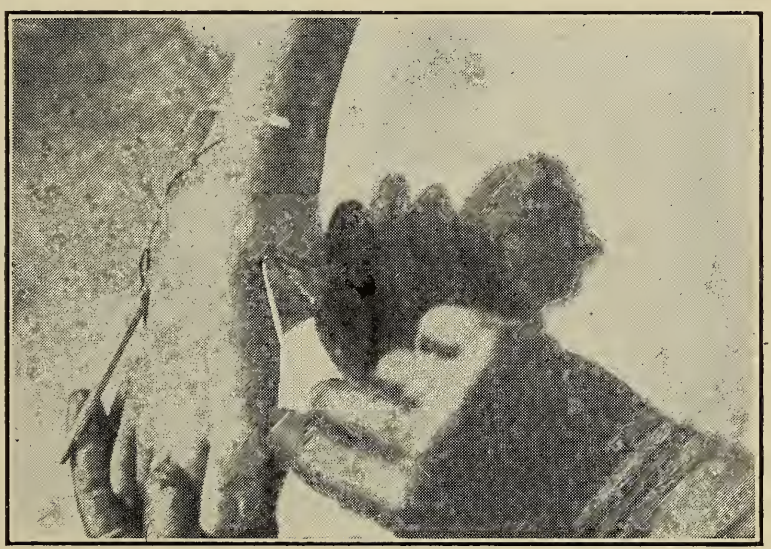


FIG. 2. The second step: inserting the threaded probes into the sheathes of the tibialis anticus and peroneus tertius muscles.

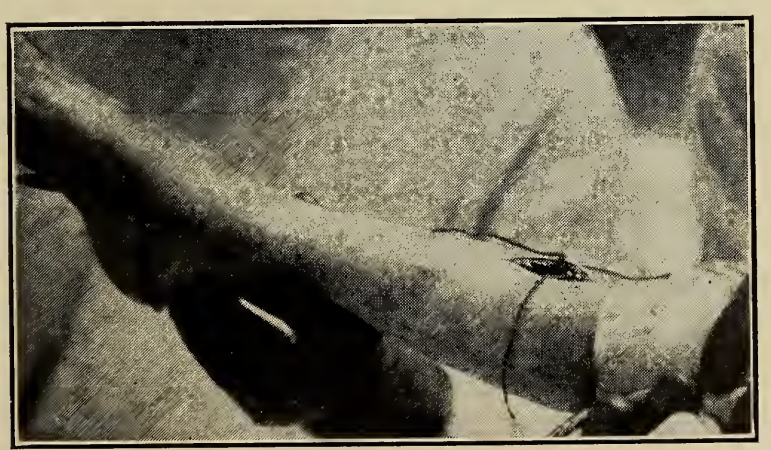


FIG 3. The third step: the threaded probes making exit at the anterior surface of the leg.

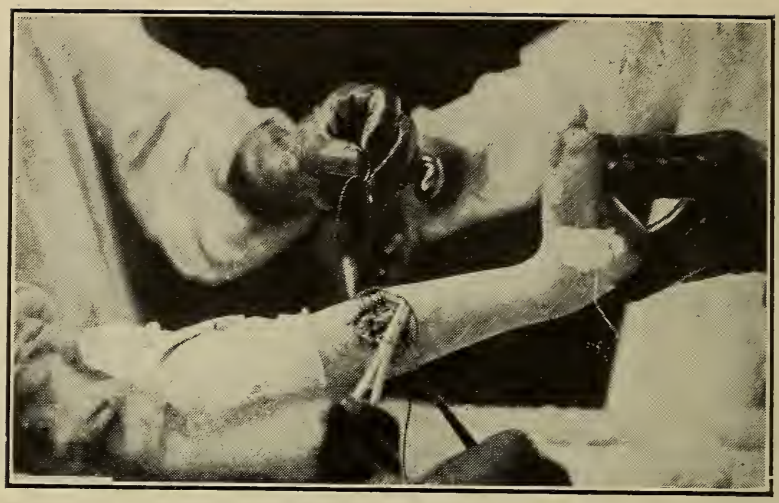


FIG. 4. The fourth step: stitching the silk to the tibial periosteum.

FIG. 5. The fifth step: the wounds closed, the artificial ligament holding the foot at a right angle to the leg.

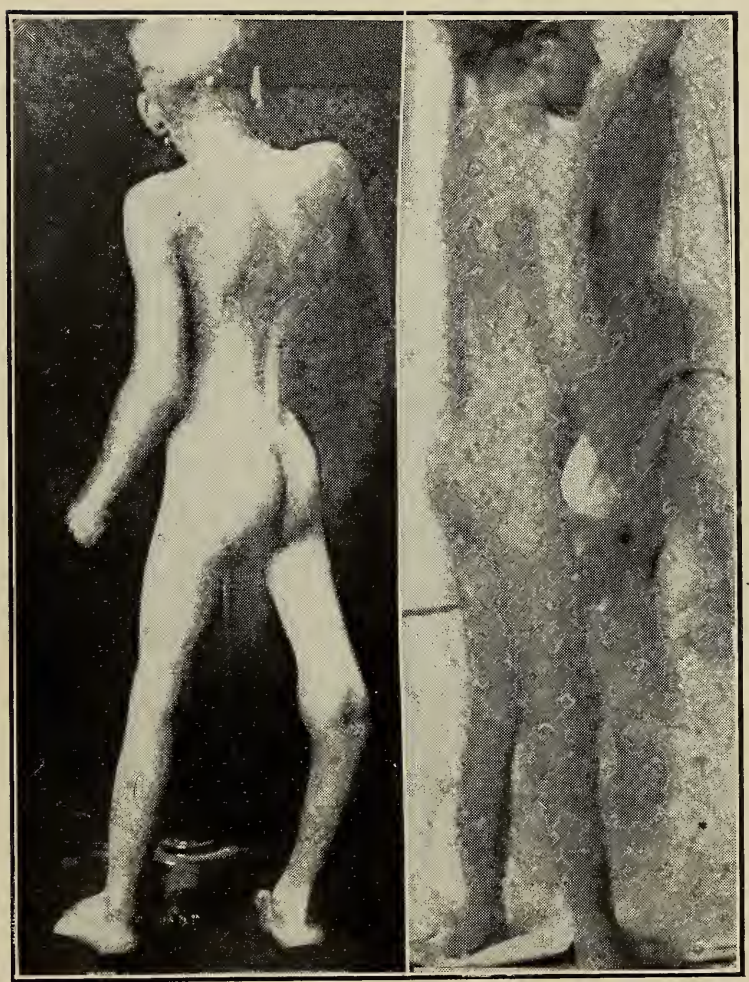
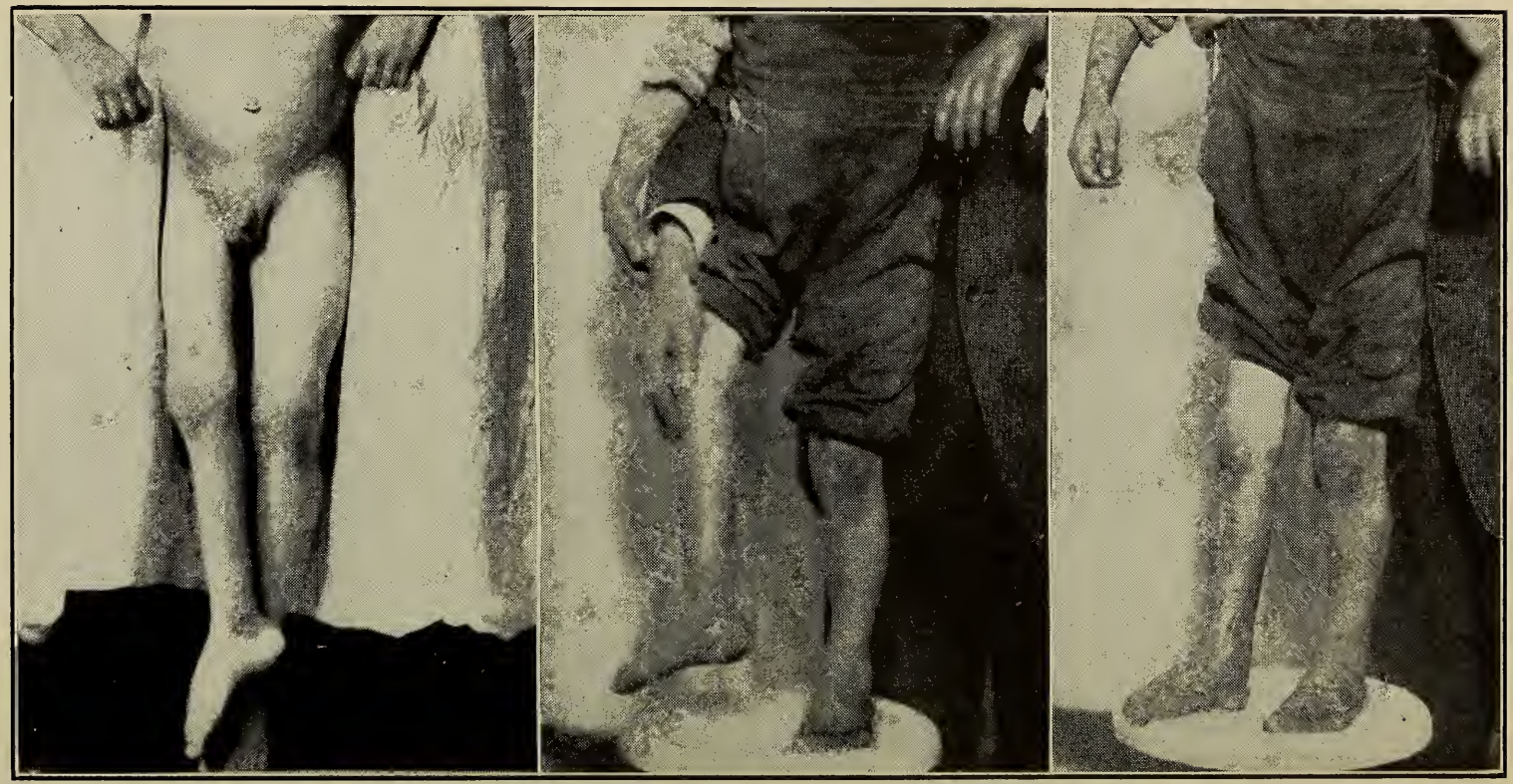


FIG. 6. A case of poliomyelities with paralysis of the hamstring muscles. Here the hyperextension of the knee, shown in the picture before treatment, was checked by artificial silk tendons, as shown in the picture after treatment.



Before operation. After operation.

FIG. 7. A case of poliomyelitis with flail ankle. In the photograph taken after operation the improved stable position of the foot can be noticed; also the presence of the artificial tendo Achilles.

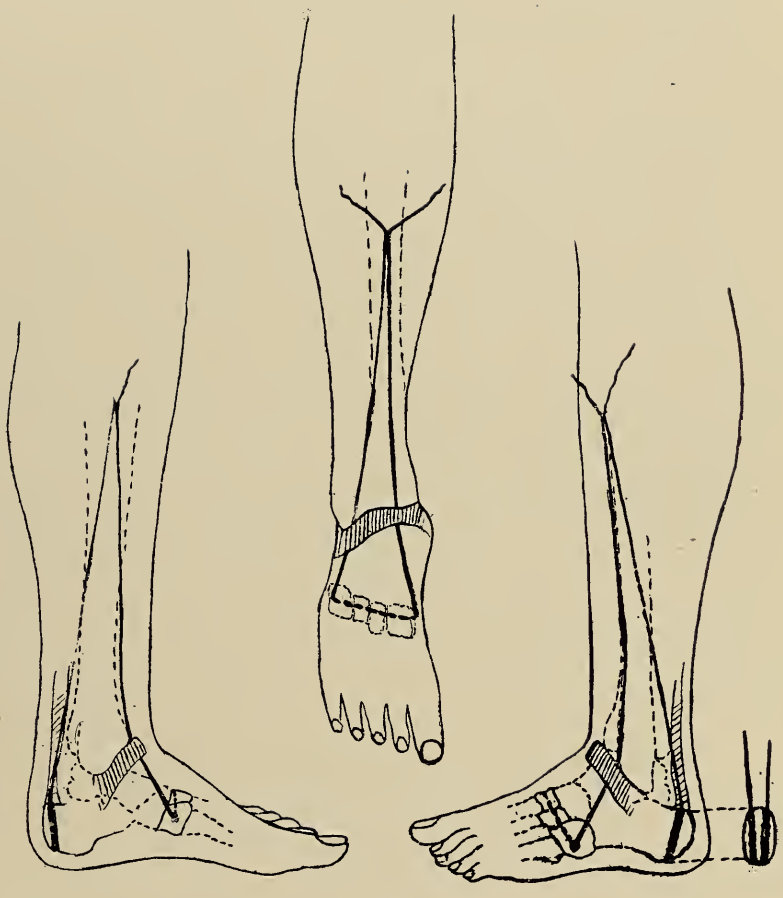


FIG. 8. Diagram showing the anatomical situation, in which it is desired to place the artificial ligaments in anterior foot and heel suspension.

through the interosseous membrane of the anterior external tibial surface. These two probe-ends are now cut upon, and the silk is removed and the probes withdrawn. The desired amount of tension is put upon the silk cords, drawing the heel well upward, and the silk is sutured to the tibial periosteum or to the bone itself. The wounds are closed and a plaster-of-Paris dressing is applied.

Operation 3.—Anterior foot and heel suspension for flail-ankle, with or without pes cavus.

The object of operation here is to supply stability to the ankle-joint, the foot being held at right angles to the leg.

As a preliminary step, if pes cavus is present, the plantar tissues should be thoroughly divided. Both Operation 1 and Operation 2 are now done, and the foot is thus held between the anterior and the posterior silk suspension in a right-angle position.

Operation 4.—Artificial ligaments at the knee for hyperextension of the knee, following hamstring paralysis.

Just below the tibial tubercle the anterior surface of the tibia is exposed. Here two strong silk cords are sutured to the periosteum or to the bone. Two of these silk cords are passed upward behind the knee, on the inner side, in the sheath of the semitendinosus. The two outer cords are passed upward in the sheath of the biceps. The probes carrying the silk are curved, so that their direction will be forward and bring them out on the anterior surface of the femur above the middle of the thigh. Here an incision is made and the probes carrying the silk are discovered. The silk is removed from the ends of the probes, the probes are withdrawn, and the silk sutured to the femur, the knee being flexed at 15 to 20 degrees. The

wounds are closed and a plaster-of-Paris bandage is applied.

There seems to be a considerable number of variations which may be made of the use of silk for purposes similar to those just described. The operations have the advantage of being easily and quickly performed, and of being based for their effectiveness on the normal anatomical pull of the tendons. There are two questions which must be considered and which are now receiving experimental attention, namely the effect produced by the silk implanted in the bones, and the reaction of the tendon-sheaths to the artificial tendons.

The writer's experience covers a considerable number of cases and dates back to one year and a half ago when the operation of anterior foot-suspension was first performed. Since then 20-odd cases have had the method employed, to afford stability at their ankles in one form or another. But one case has been operated upon to check hyperextension at the knee. In none of these cases has the silk shown any tendency to come out, nor has there been an infection. The after-treatment of these cases should be carefully overseen for at least a year. Plaster-of-Paris dressing must be worn for the first six weeks. After this, braces may be supplied, which will suport the limb and protect the artificial tendons from undue stress, the idea here being to give the tissues a sufficient period of time to produce fibrous tissues in sufficient quantity to insure permanency of the support.

DISCUSSION

Dr. Daniel N. Eisendrath (Chicago): The paper to which we have just listened is a very timely one in view of the fact that we are having all over the country epidemics of poliomyelitis, with disastrous results, and many of these cases of poliomyelitis need surgical correction. I have had three cases

similar to those that have been reported, and the result in one of them was particularly gratifying. I believe in the future I shall use this method of silk in preference to arthrodesis in every case. The case to which I refer I saw last summer; two years after the original operation I exhibited the patient to a number of surgeons in Chicago. The case was quite similar to the one shown here today. The patient was a girl with paralytic flat-foot, with a marked flail ankle-joint on one side, and traumatic club-foot on the opposite side, with flail joint. The technic I pursued was a little different from that carried out by Dr. Allison, in that it consisted in not limiting myself to a small incision, making quite a large incision on the outer and inner aspects of the ankle-joint, and in that way I could sew the tendon for some distance up where I wanted to make the transplantation, and had better access to the joint, which is very essential. I do not know the origin of the method, but I have attributed it to Lange. I remember reading a number of cases reported by Sutherland of Boston. The method consists in putting on, as Dr. Allison has outlined, a number of silk ligatures as supports to the ankle or knee joints. In the case I have mentioned I used three silk ligatures, sterilized by boiling for ten minutes in a one to one thousand bichloride of mercury. I inserted them into the lower end of tibia and fibula and carried them over in three directions to the smaller tarsal bones of the foot, and, in one case, almost to the metatarsal. I saw the girl last summer. She walked without any splints or appliances of any kind, the flat-foot and deformity having been completely overcome. We asked her to walk up and down in the office, and at the hospital later on, and there was not the least motion to the ankle joint, that is, there was no lateral motion. The transplantation of the tendons in that case probably was not a success, and I believe we have much to wish for in that direction.

Dr. John P. Lord (Omaha, Neb.): I have given particular attention to this line of work since its inception, and because of my association with our State Hospital for Crippled Children at Lincoln I have had rather exceptional opportunities for putting into practice the principles, outlined in Dr. Allison's paper. I have had enough experience to cause me to ask some questions in regard to the permanency of some of these methods. Silk is a foreign body, and, in the best of hands, in exceptional instances it will become a source of trouble. This foreign body introduced into a limb to remain, ever and always, and introduced on certain principles, expect-

ing it to carry out certain definite things, it seems to me will be modified by the growth of the child. For instance, in the method advocated by Ryerson, of Chicago, of introducing a silk ligature beneath the annular ligament of the ankle, there is firm bony attachment anteriorly in the tarsus; there is a firm, unyielding attachment throughout the tibia above. With the growth of the leg and foot, the silk tendon with the tension on the angle that is made by the annular ligament at the apex of the triangle is not going to hold there; it will cut through the annular ligament rather than yield at either end.

As to the permanency of this material, will it last for twenty years? In many of these cases we can do secondary operations to correct defects that arise because of these artificial aids, so we can well afford to receive the benefit as we go along and make further corrective procedure at a later time, if necessary. I have recently had occasion to review the literature in regard to bone-work, and there seems to be a distinct tendency to use autoplastic tendons and sutures, such as can be readily secured from the fascia lata and from the region of the wounds, or from the same wound; if it happens to be the shoulder, from the dense fascia covering the deltoid region. In some operations recently reported, notably by Dr. Lewis, of Chicago, in his paper read last summer before the surgical section of the American Medical Association, new ligaments of fascia rolled into a considerable substance were used to take the place of the paralyzed deltoid, in connecting the trapezius at the deltoid insertion. I find practically everywhere among operators doing this class of work that there is a distinct tendency to return to the use of the normal tissues of the body rather than to depend upon foreign material, and their use and permanency are just as well established as are those of the other materials. Which is going to obtain ascendency I do not know, but, it seems to me, in some of these procedures in which silk is used, we are going to yield to the other material.

Inasmuch as this field of endeavor is relatively new, not much more than ten years old, it has developed most wonderfully, and the application of these methods has found many fields. The numerous epidemics throughout this country of anterior poliomyelitis, and the number of cases that can be benefited by these methods, are legion, and it has given an opportunity for a number of men to do most excellent work. The field is only just opening up, and it would seem that general surgeons and general practitioners, men who have

not had their attention directly called to this class of work, are really not in the foreground of this matter, and it therefore especially requires emphasis, and I think we are indebted to Dr. Allison for presenting this matter to us.

Dr. L. L. McArthur (Chicago): As a source of supply for living tendon material, I would call attention to hernia. The tendon of the external oblique, whose tendinous fibers can be readily dissected out in bundles of desirable size to the length of six inches in the adult and five inches in the child, forms the source of supply. Recently Davis has been transplanting fascia and tissues experimentally by taking them out of one part of the body and putting them in another, and that is what we do when we use a strip of the external oblique to sew up the hernia. I have recently taken strips of the fatty fascia of the arm to surround the musculospiral nerve, when caught in a callus.

MENINGOCELE, ENCEPHALOCELE, AND HYDRENCEPHALOCELE

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A certain class of anomalies of the brain are termed *cephalocele.* These are divided into meningocele, encephalocele, and hydrencephalocele.

DEFINITION

In meningocele there is a soft fluctuating tumor filled with fluid and in more or less direct communication with the subarachnoid space.

In encephalocele there is a greater or less quantity of brain tissue adhering to the internal surface of the membranes. At times the entire tumor is made up of brain tissue, but, as a rule, it is composed largely of cerebrospinal fluid.

Hydrencephalocele is composed of membranes, a thin layer of brain tissue, and the cerebrospinal fluid, the latter being in direct communication with the ventricles of the brain. These abnormalities are most frequent in the occipital region, and the opening in the bone may be either above or below the tentorium. If situated above, it may be in connection with the posterior fontanelle, and, if below, it may enter the foramen magnum.

Cephalocele is not infrequently encountered in the nasofrontal, naso-orbital, and naso-ethmoidal region. The sincipital or frontal cephalocele usually occurs through the longitudinal plate of the ethmoid, near the base of the nose.

A cephalocele may occur also at the side of the skull or at its base.

ETIOLOGY

Embryologists, pathologists, and surgeons are by no means agreed as to the cause or causes of these different conditions. It is, however, generally admitted that there is a great similarity between congenital affections of the cord and those of the brain, the former being known as rachischisis partialis or totalis, the latter as cranioschisis, acrania, or hemicrania; and that in a measure what holds good for the one will also be true of the other.

It was primarily held that these abnormalities were due to an internal hydrocephalus occurring in the embryo before the fourth month. (Morgagni, Haller, Marshal Hall, Spring, Soemering, Meckel, v. Bergmann, and to some extent also Virchow and Ahlfeld.)

V. Bergmann held that a "meningocele occurs from retrograde changes in hydrencephalocele; the brain tissue of the latter disappears; beneath the arachnoid is a layer of cells identical with those which line the ventricle; the connection with the ventricles is entirely or nearly shut off; a cyst forms in the subarachnoid tissue, and thickened pia surrounds the cyst."

There are many pathologists and surgeons who are in agreement with this view. Mr. Kellock, surgeon to the Great Ormond street hospital for children, London, said to the writer during the past summer that he was certain from his operative and microscopical work that occipital cephalocele, excluding meningocele, had its origin in a dilatation of the 4th ventricle, and that protrusions occurring laterally had their origin in dilatation of some portion of the lateral ventricle.

It would seem quite natural to attribute hydrencephalocele to internal hydrocephalus, but I am very credulous about the other forms of cephalocele.

As opposed to this theory, it was first pointed out by Dareste that the hydrocephalic embryo would die early. It is also claimed that the dermal covering of the area cerebrovasculosa and the convex skull-base speak against this theory; also that intra-uterine hydrocephalus does not cause splittting of the cranial vault, or the congenital arrests in development which are frequent in these abnormalities.

THEORY OF TRACTION-BANDS

Another theory is that of traction-bands formed by union of the amnion with the ectodermal portion of the fetus. (Marchand, G. D. Hillaire, Virchow, and Ahlfeld.)

The theory of Dareste and Lebedeff points to a bending in the cerebrospinal axis (kyphosis.)

Errors in arrested development were first suggested by W. Harvey and promulgated by J. F. Meckel.

FAILURE IN DEVELOPMENT OF MEMBRANA REUNIONS SUPERIOR

H. Reinke suggests as a cause the combination of the skin layer with the differentiating neural tissue.

Schwalbe's theory is that the condition is essentially due to failure in development of the epidermal tissues from chemical, thermal, or mechanical causes.

Another view is that the separation between the neural tube and the ectoderm is incomplete. (Forneux.)

Ziegler thinks that the defective development is due to some primary defect in the germ.

Adami believes that germinal intoxication is the most frequent underlying cause.

Cushing says that these congenital anomalies are more or less associated with circulatory disturbances in the cerebrospinal fluid, and that the opening in the skull is not the primary factor in causing the hernia,

but rather intracranial conditions tending to increase the tension of the cerebrospinal fluid; as, for instance, following craniectomies there is no bulging of the membranes unless there is increased intracranial tension. The cerebrospinal space is formed and contains fluid before the membranes are formed, and it is held by some that should there be any abnormal pressure in the cerebrospinal fluid it might bulge the membrane through the area where the solid closure of the lateral plates was not far advanced.

According to von Recklinghausen, failure of closure of the neural groove is due to a locally deficient growth of the mesoblast. It is also held that the condition may be due to irregular division of the brain, in consequence of which some parts come to lie outside of their mesodermic coverings.

FAILURE IN CLOSURE OF THE MEDULLARY GROOVE AS CAUSE

The central nervous system is formed from a groove-like invagination or fold in the superior germinal layer. When the walls of this fold unite posteriorly, the medullary groove, which was open originally, becomes the closed medullary tube. This tube is separated from the superior germinal layer and forms the rudiment of the brain and spinal cord. The lumen of the medullary tube then corresponds to the central canal of the spinal cord and ventricles of the brain. When fusion of the walls of the medullary groove fails throughout, fissure of the back and skull results (craniorachischisis). Failure of closure of the medullary groove hinders the development of the vertebral arches, muscular and cutaneous coverings. (Thoma). When the patency of the medullary groove is confined to the spinal cord, rhachischisis totalis or partialis occurs. When the failure of closure of the medullary tube is limited to the region of the brain, cranioschisis, acrania, or hemicrania is the result.

Lebedoff was the first to demonstrate that persistent patency of the medullary tube was a cause of these conditions. Thoma supports this theory, and says that in both rachischisis and cranioschisis the persistent patency of the medullary groove, apart from some cases of ruptured hydrocephalus, forms the anatomical condition which determines the lesion.

Paul Ernst, of Heidelberg, says that these malformations depend on an arrest of fixation of certain stages of development, and that the determining element may be operative for only a time, permitting a subsequent though heterotypic development.

Like malformations have been produced in the embryos of the lower animals by means of thermic, chemical, and mechanical causes; and it is thought possible that in human beings the toxins of syphilis or alcohol, or the temperature of febrile conditions, or injuries, may be active in causing an arrest in development.

It seems well established that the severe malformations of the back and head are due to failure in closure of the medullary groove. This is probably also true in a great many other malformations of less degree.

THE COVERINGS

There is much uncertainty regarding the coverings, and at times no little difficulty in determining just what the coverings are. V. Bergmann held that the epicranium, skull, and dura were deficient. This at least is generally true in hydrencephalocele. In some cases the skin covering is also absent. Paul Ernst says that usually in meningocele occipitalis the dura is wanting. The fluid is usually in the subarachnoid space; it may also occur beneath the dura or in the superficial tissues.

CAUSE OF FLUID ACCUMULATION

It is held by many that the hydrops is due to an inflammatory reaction, the result of the stretching, bruising, or infection of the exposed membranes, or to pressure in the absence of the dura and spinal arches, leading to a hyperemic condition of the pia arachnoid, with increased secretion.

DIAGNOSIS

In consequence of the tumor being congenital, usually situated in the median line, being soft, fluctuant, often translucent and increased by crying or straining, the diagnosis is reasonably easy. Errors in diagnosis, however, do occur. Congenital dermoids are also found along the median line of the skull. A pulsating angioma may have to be differentiated; or a benign tumor or a sebaceous cyst may be situated directly over a cephalocele. It is stated by Cushing that ethmoidal hernias have often been mistaken for nasal polypi.

TREATMENT

In cases of meningocele, after the strictest aseptic precautions have been taken and with the patient in practically a sitting position, two curvilinear incisions should be made around the base of the sac and far enough removed from the opening in the bone to secure enough of the skin for a covering after removal of the tumor. These incisions are gradually deepened down to the innermost covering of the sac, which is separated well up into the opening in the bone. The base of the sac should then be ligated close to the opening with catgut, and the sac removed. The closure of the sac should then be reinforced by a continuous suture of catgut over its cut surface, as it is absolutely necessary that the suture-line be watertight. Over the stump the skin is brought accurately

together by interrupted sutures. If the base of the sac is large, it may be necessary to draw off part of the fluid before ligation.

In two of my cases I ligated portions of the cerebellum, the condition being disclosed on cutting away the sac. The ligature was divided, and the protruding portions pushed back through the opening in the occipital bone, when the ligature was reapplied. In cases of small hydrencephalocele the brain-tissue, if possible after dissecting off the skin, should be pushed back through the opening into the cranium, after having withdrawn some of the fluid in the ventricle to aid this purpose. Then the sac and integument are closed as before. If it is not found possible to replace the extruded portion of the brain it may be excised. Kellock says that in hydrencephalocele he has never seen a child reach puberty after excision of the protruding mass, and that while they may survive for a time they are always mentally very defective.

There seems to be a marked tendency for a cephalocele to return after operation. I have not seen this happen in cases in which there was a good pericranium or skin-covering to close over the defect. When the defect in the bone is large recurrence is much more likely. The opening may be lessened in size or closed by sliding in a piece of bone from the adjacent area, or by filling in the defect with pericranium or skin. If the dura is present this will help very materially in preventing recurrence.

CHRONIC INFECTIVE TENOSYNOVITIS: REPORT OF A MOST INTERESTING CASE

William W. Grant, M. D.

DENVER, COLORADO

Simple circumscribed cyst, usually affecting the tendon sheaths on the back of the wrist, is a simple affection, generally single, the contents being a thick liquid resembling quince juice in appearance and consistency. It is commonly designated a ganglion. Its treatment is simple and will not be further considered.

Acute infective inflammation of the tendon sheaths is usually due to trauma, or is secondary to nearby disease of the bones or joints, or may be due to a general septic condition. It is frequently multiple. If suppuration results, it is a serious condition and requires free incision and drainage. The chronic disease is most interesting, and, when several tendons are extensively involved, is rather unusual. It may be a sequel to the acute affection, but not necessarily so. It is always a serious condition to muscular function, and sometimes dangerous to life. The chronic infection of the tendons and sheaths of the forearm and wrist especially, is believed to be due generally to tuberculosis and is called compound ganglion or tuberculous thecitis. Gonorrhea, syphilis, gout, etc., are in the etiological list.

The following case is the most extensive that I have yet seen, involving *all* the most important flexor muscles of the hand, the flexor carpi ulnaris, the flexor carpi radialis, and the flexor sublimis and profundus digitorum.

Sam Branum (colored), aged 53 years. Occupation, for the past fifteen years, janitor of the First National Bank of Denver, Colorado. His occupation required the constant daily use of his hands in manual labor. Five and a half years before calling on me, the fingers of the left hand were affected, though not severely, with what was called rheumatism. This condition gradually extended, in the course of a year, to the front of the wrist and forearm. Although mild, the disease was progressive, extending slowly to the palm and up the arm, at times remaining stationary. It continued in this way with slight pain at times and swelling, gradually increasing until January, 1911, when the pain, swelling, and fever increased rapidly, completely disabling the hand and arm in the course of a few weeks. This was the condition when I first saw him. The hand was absolutely helpless, with some anesthesia, due doubtless to pressure. His fingers were in a state of partial flexion, and he was unable to flex or extend them in the slightest degree.

Examination showed the palmar surface of the hand and arm greatly swollen, the fingers, except the thumb, not seriously involved in the swelling, and the constriction of the annular ligament making a sharp line of distinction in the appearance of the hand and arm. Pressure and manipulation revealed a soft, doughy feeling and deep fluctuation from the arm to the palm and thumb. The extensor muscles were not involved in the slightest. He states that he had syphilis thirty years ago, for which he was indifferently treated for about a year.

Operation at St. Luke's Hospital on March 18, 1911. A central incision was made through the skin and deep fascia from the upper third of the arm to the middle of the palm and a connecting incision to the distal phalanx of the thumb, following the course of

FIG. 1. Two weeks after operation.

FIG. 2. Three months after operation.

the flexor longus pollicis, which was infected and enormously distended throughout its entire extent.

There were no adhesions between fascia and tendons, but the latter were adherent *en masse,* and the veins greatly engorged. The annular ligament was divided, the tendons treated separately, and the thickened distended sheath of each split through its length and trimmed with scissors. Each sheath was distended with a thick, grumous, odorless material resembling yellow corn-meal gruel. In the belly of the sublimis digitorum there was a circumscribed cyst containing about a tablespoonful of this material, the capsule or membrane being almost as rigid and thick as cartilage. No rice bodies, peculiar to tuberculosis, were found. There was a similar mass in the palm with thin capsule, not in direct communication with a tendon. Some tendons were softened by a degenerative process. The capsule and the material from cysts and tendon sheaths were delivered to a pathologist for examination, whose report follows:

Sections from the tissues removed from the wrist of Mr. Branum showed a general necrosis of the tissue. The contour of the muscle bundles and adjoining connective tissue could barely be discerned, the whole field presenting an almost homogeneous mass except for numerous collections of small round cells of the lymphocyte type.

There was no sign of any tubercle formation or anything resembling giant cells. Nor were any tubercle bacilli found in sections specially stained for that microörganism.

The Wassermann reaction made on two separate occasions a month apart, was negative.

Histologic diagnosis: Necrosis of tissues due to an infection, the exact nature of which could not be ascertained.

PHILIP HILLKOWITZ.

During convalescence, the patient was given iodide of potassium and mercury alternately. I think the condition may have been syphilitic.

The wound was thoroughly irrigated and mopped with peroxide of hydrogen and salt solution. The

carpal joint was not implicated. The annular ligament was sutured separately, and the wound closed, with the insertion of a few small iodoform-gauze tents here and there, as shown in photograph No. 1, taken two weeks after the operation. The wound was dressed with sterile gauze and bandage. A mild elevation of temperature followed for four or five days with a slight discharge of pus from the wound, chiefly in the vicinity of the wrist-joint. Gentle passive motion of the fingers, hand and arm was instituted a week after the operation and continued with increasing vigor for four months, with the object of limiting the adhesions as much as possible. The swelling and discharge gradually subsided and the discharge practically ceased at the end of two months. The fistulous tracts were irrigated daily with strong iodine solution and finally treated with bismuth paste, to which was added balsam of peru. At the same time, the Bier hyperemia treatment was applied one hour daily, above the elbow, for three weeks. Three months after the operation the patient was discharged perfectly well, with arm and hand well shown in photograph No. 2.

At the present time the wrist motion is almost normal, though it still creaks a little on extreme flexion. Flexion of the middle and ring fingers is excellent, but in the second and distal phalanges of the index and little fingers, and the distal phalanx of the thumb, the flexion is practically lost, due either to sloughing or to powerful adhesions of the deep fibers of the flexor sublimis digitorum and the flexor longus pollicis. The thumb is easily abducted as shown in the illustration and with good flexion of all metacarpophalangeal joints and almost normal flexion of the middle and ring fingers, the patient has a very useful hand. While it could probably be improved by plastic tendon operations, he is so well pleased with the re

sult that he is not anxious to submit to further operative procedure.

With negative examination and tests for tuberculosis including the skin test; with a negative clinical history of tuberculosis, and a negative Wassermann; with a probable positive clinical history, many years ago, of syphilis; with no open wound infection, and no proven trauma, unless that which may come from the pressure and strain of occupation, I do not believe any positive assertion can be made as to the etiology. There is no history of gonorrhea nor of gout. For many years preceding his recent illness, he was a free drinker, sometimes to intoxication. Whatever the influence of alcoholism on the Wassermann reaction; whether it inhibits, as some believe, or makes one more sensitive to the test, as Sarbo and Kiss recently claim, the patient was neither drinking nor taking medicine when the last Wassermann was made.

The statement of these writers that "neither therapeutic nor prognostic conclusions can be drawn from the Wassermann reaction alone" is interesting, and the suggestion might, with propriety, be extended so as to include the question of diagnosis. With one tendon involved or in compound ganglion of limited extent, adjacent fascia might be used as has been suggested, to envelop and protect the tendons from vicious adhesions; but in extensive multiple tenosynovitis with an extensive infection, with suppuration, no method with this object in view would likely succeed, but *after* recovery resulting adhesions may be remedied by fascial flaps with a fixed point, or by transplantation of fascia, as experiments and experience have shown to be entirely feasible.

DISCUSSION

Dr. Arthur E. Hertzler (Kansas City, Mo.): I recently had a patient presenting somewhat the gross appearance of this condition, and we were able to demonstrate in this case

that the lesion belonged to the group of lymphangiomas. A photograph, shown by Dr. Mann, I think, in Omaha several years ago, showed a similar condition in the leg.

I have been trying to find out by studying the literature what justification the older writers had for classifying these lesions as tuberculous, and it strikes me that their presumption is based on a rather uncertain footing. In my case certainly, and I have suspected in some others, the lesion really is a tumorous formation belonging to that peculiar class of hyperplasias half between telangiectasis and tumors.

Dr. James E. Moore (Minneapolis): I would like to ask Dr. Hertzler if in these cases of tuberculous tenosynovitis rice bodies were present.

Dr. Hertzler: That, I think, is a different condition. If I understood Dr. Grant correctly, he said there were no rice bodies present.

Dr. Grant: Not one.

Dr. Hertzler: In those cases in which rice bodies are present it is fairly well established that they are inflammatory in origin, and I should question whether they were of tuberculous origin. In searching the literature it is hard to find the dividing line in this type of lesions between what was written before and what was written after we learned what tuberculosis really is. We have gotten into the habit of calling some of these cases tuberculosis without proving whether they are or not.

Dr. James F. Percy (Galesburg, Ill.): The simple localized distension of the tendon sheath, as we all know, is very common. The extensive involvement of the tendon sheath, as reported by Dr. Grant, is not so common.

My first case that can be compared to the one reported here, was in the hand of a woman who was a professional pianist. Before I got through with the patient, I had made a most extensive dissection that opened up the whole hand. The case occurred about seventeen years ago. I was fortunate in getting a perfect functional result, although the hand was badly scarred. I rise, however, to report a treatment that was reported in *Surgery, Gynecology and Obstetrics,* August, 1905, p. 170. It consists of the injection of equal parts of camphor and chloral into the ganglion. This has proven most efficient in the treatment of these cases, some five in number. A few drops are injected and the hand put at rest on a splint for three or four days. One of these cases sloughed

out, probably from injecting too much of the mixture. For a time I was afraid of the functional result in this case, but, with the exception of a pronounced scar, it was good.

Another very interesting case, that was much like the one Dr. Grant has reported here, occurred in my practice last year, in the case of a physician. His hand was practically useless from this condition and I was afraid to inject the solution in this case, and advised him to have the hand operated on. He was loathe to have that done, and, incidentally, came under the observation of Dr. Pusey, of Chicago, a dermatologist. Dr. Pusey laughingly told him to take internally a proprietary remedy that is known under the name of colchi-sal. It is a preparation, I believe, that is made in France, and sold by some firm in New York. All of us have had samples of it. The physician did this, with the result of an entire disappearance of all the symptoms, and the recovery of a very useful hand.

What the etiology of the condition was, based on the standpoint of that treatment, I do not know; I merely mention it as an interesting fact that occurred under my observation.

Dr. Grant (closing the discussion): In reference to Dr. Hertzler's question, I know nothing further as to the pathologic condition than as stated by the pathologist. Dr. Powers asked me to let him know the day I was going to do the operation, as it was a most unusual case to him. When the tissue and fascia were laid back, leaving this livid mass, one not knowing anything about it would imagine it was a sarcoma, as the muscles and tendons were all glued together. The sheaths of the tendons were greatly thickened, and in places softened. Beyond that and the extreme thrombotic condition of the veins, there was nothing peculiar about it. The results were normal, even though one of the cysts in the belly of the sublimis digitorum before the tendon was given off, was distinct from the tendon sheath proper. I do not believe any system of treatment by injection would have availed in this case, because in an extensive condition like this it would have been impossible to have treated this case without first making an extensive operation and injecting each tendon separately, and to do that one would have to get rid of the thickened tissues, but the liquid content was so thick that it would not run out, it had to be scooped out. Therefore, in splitting the tendons and cutting away the excess of tissue and that which was loose, one of the tendons was softened, yet in some respects it was intact.

The case was an unusual one to me, and I think it worthy of being reported, especially in view of the doubt as to the exact nature of these growths. It extended to the upper third of the arm, and by pressure you could distend this cyst, or tendon, from the metacarpal phalanx of the thumb to the distal phalanx, so that it touched the palm. It was an enormous growth. There were one or two cupfuls of material in the tendon sheaths, and in the different locations mentioned.

CONGENITAL MALFORMATIONS OF THE URETERS

Daniel N. Eisendrath, A. B., M. D.

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The object of the present paper is to add another case of congenital malformation of the ureter to the series of four similar cases reported by the writer in two previous articles, published during the past year.

In order to permit of a survey of the entire five cases, and to bring out the various forms and clinical pictures shown by them, I shall give a brief synopsis of the already published four cases.

Case 1.—Congenital hydronephrosis of a horseshoe kidney.

Boy of six, with severe right abdominal pain, septic symptoms, and palpable transverse tumor in upper abdomen. The latter at operation (Fig. 1) was seen to be a hydronephrotic horseshoe kidney. Ureter not enlarged. Operation consisted of draining sac. Existence of closure or narrowing of ureter at junction with renal pelvis is assumed from absence of dilatation of ureters and from similar cases collected by Papin and Christian. They found that the cause of the hydronephrosis in fifteen cases of hydronephrotic horseshoe kidneys seen at autopsy, was either congenital stricture or faulty insertion of the ureter. In this case the condition had remained latent until infection occurred.

Case 2.—Congenital hydronephrosis, due to stricture at the ureteropelvic junction.

Boy of twelve, with enlargement of left side of abdomen, only noticed after sixth year (Figs. 2 and 3). No symptoms referable to urinary tract. Soft elastic retrocolic tumor to be felt to left of median line, extending from costal arch to Poupart's ligament, and having distinct notch. Urine was very turbid and contained many pus corpuscles. No fever or other evidence of infection; only marked malnutrition.

At operation an immense hydronephrotic kidney was found. The sac contained two quarts of turbid fluid, which showed no growth on the ordinary media. The pelvis and calyces were enormously dilated at the expense of the parenchyma (Fig. 4). The cause of the obstruction was found to be a sudden narrowing of the ureter (Fig. 5) at its junction with the renal pelvis. It was impossible to pass even a filiform bougie through the ureteral lumen at the point of obstruction.

After the removal of the kidney, the patient made an uneventful recovery and has remained well.

Case 3.—Boy of fourteen, previously well, was suddenly seized with left-sided abdominal pain. The latter was most marked in the left iliocostal space and radiated toward the front of the abdomen. Temperature, 101°. Left side of abdomen, rigid. Urine contained a few pus corpuscles. Urinary retention was present, so that it was necessary to catheterize. No cystoscopic examination or collargol injection of ureter was made. Diagnosis before operation was some left intraperitoneal infection, possibly from the appendix, or diverticulitis of the sigmoid. Under anesthesia, a spindle-like tumor (Fig. 7) was felt beneath the left rectus muscle, tapering sharply toward the true pelvis. When the peritoneal cavity was opened, a translucent, elongated, fluctuating enlargement was found lying behind the peritoneum, to the inner side of the descending colon. The ureter was exposed through the usual oblique incision. The tissues around the ureter were

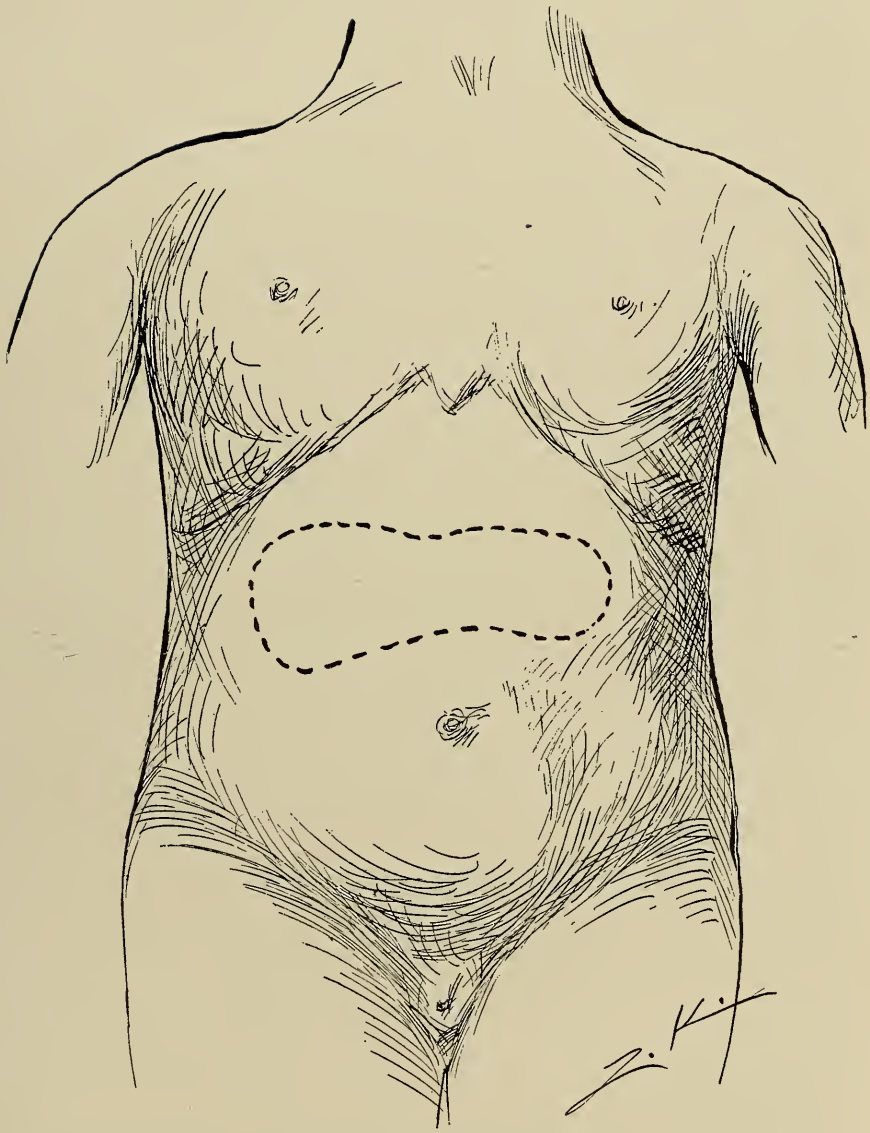


FIG. 1. Outline of hydronephrotic horseshoe kidney on abdomen. (Case 1.)

FIG. 2. Front view of abdomen in congenital hydronephrosis. (Case 2.)

FIG. 3. Result of inflation of colon in Case 2.

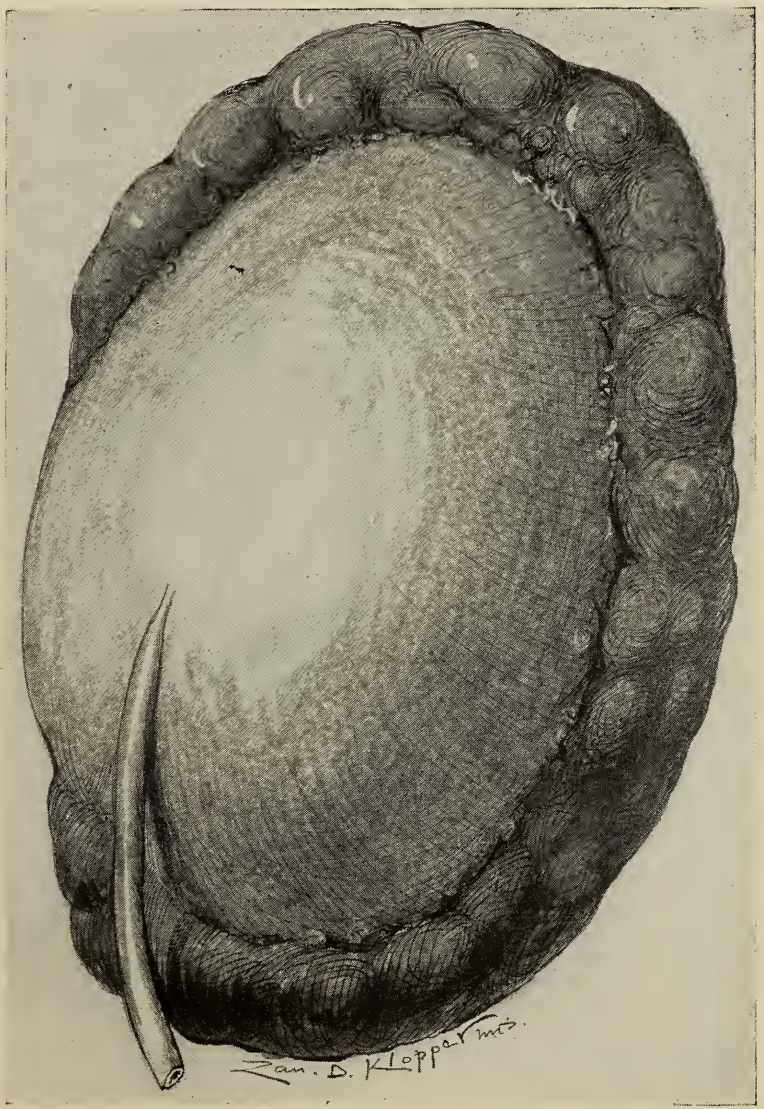


FIG. 4. Front view of kidney of Case 2. This shows the enormous dilatation of the pelvis and the narrow margin of parenchyma with prominences due to dilated calyces. Note narrowness of ureter at junction with pelvis.

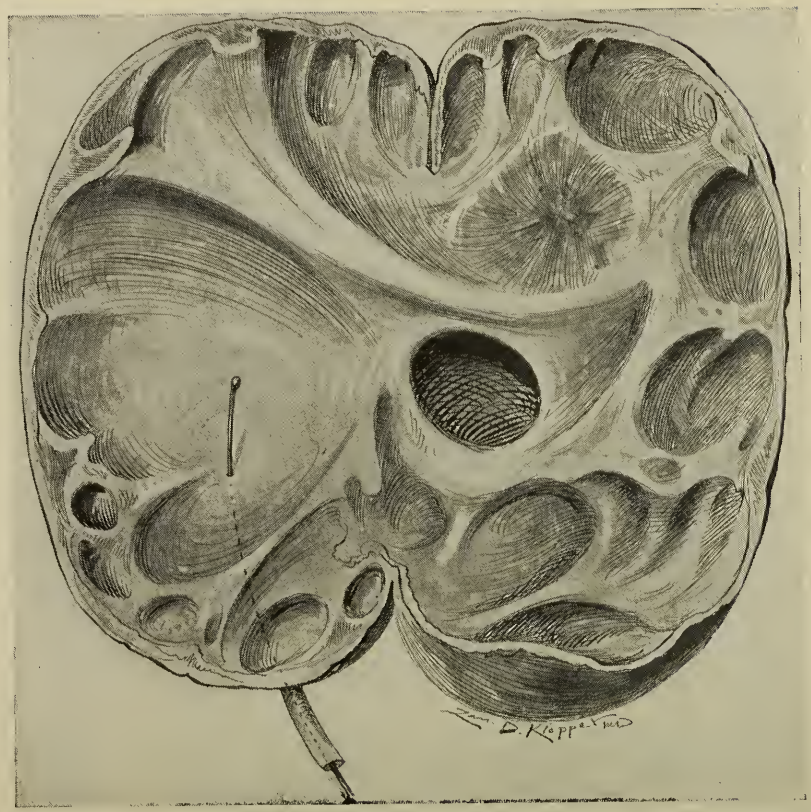


FIG. 5. Interior view of kidney of Case 2. Note narrow rim of kidney tissue, dilated calyces and pelvis, and small orifice of ureter (probe inserted through ureter).

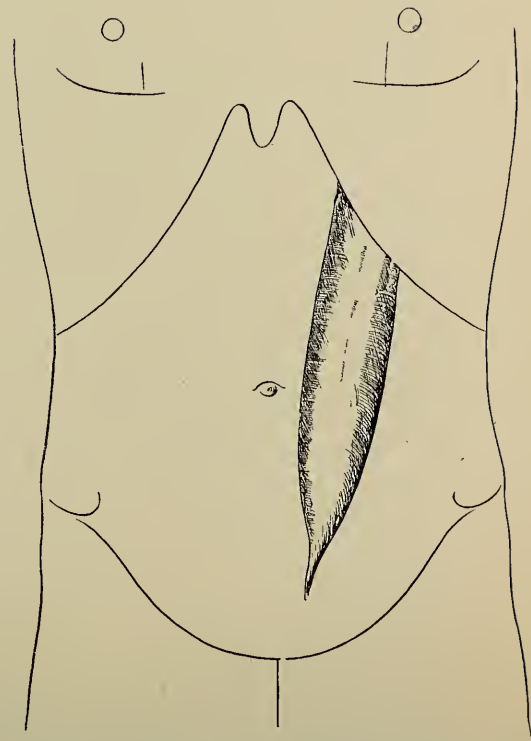
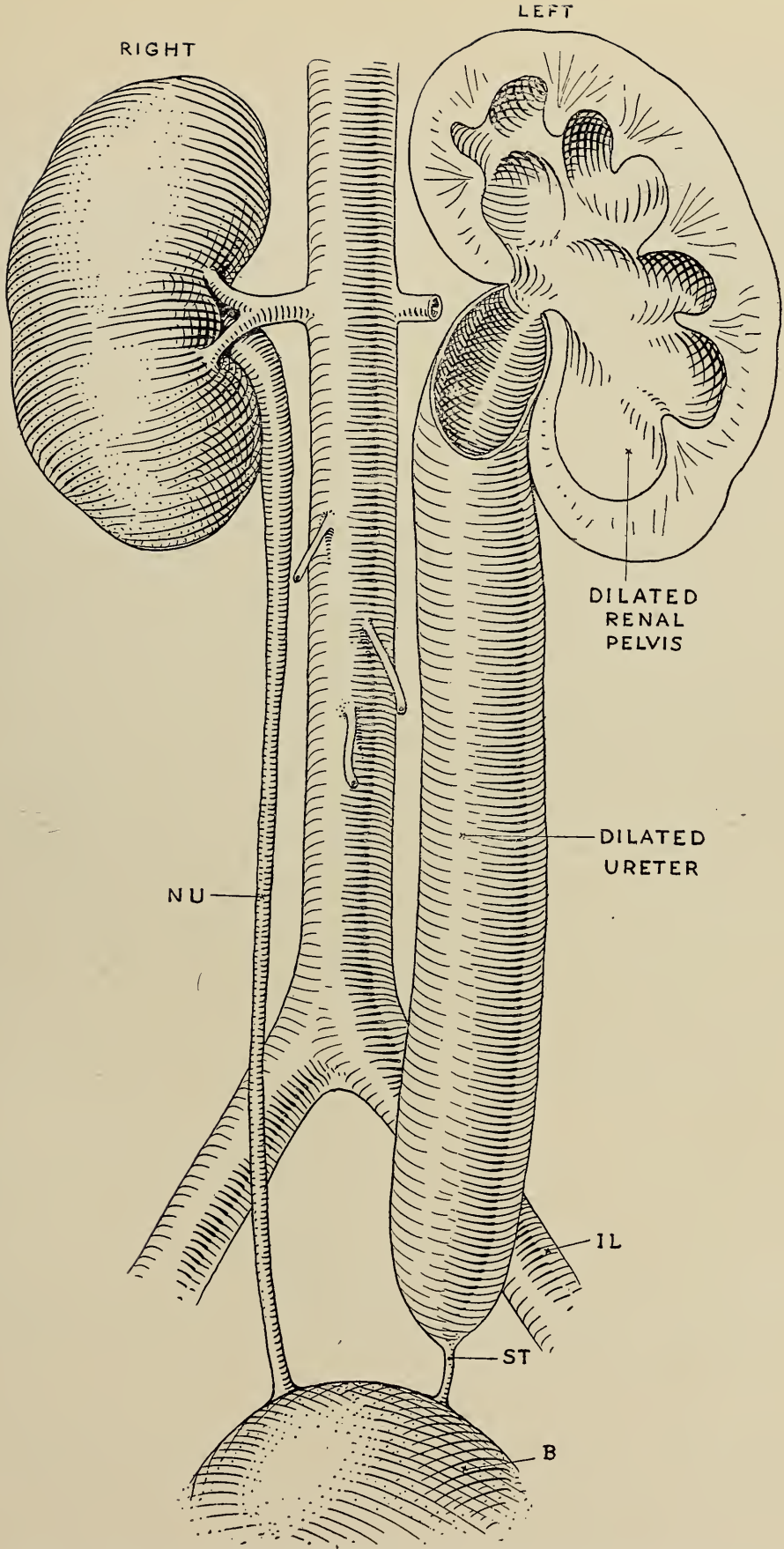


FIG. 6. Spindle-like tumor felt on outer side of left rectus (under anesthesia). It tapered toward the pelvis. (Case 3.)



Author's case of congenital stenosis of the left ureter (see text). *NU*, normal right ureter; *IL*, iliac artery; constriction (*ST*) was just distal to the place where the ureter passes across the vessel. *B*, bladder. (Semidiagrammatic.)

FIG. 8. Specimen obtained at autopsy from Dr. Abt's case of an infant, ten days old, who had died of icterus neonatorum. Note narrowing of the ureter just above the bladder and again just below the renal pelvis. Proximal to each one of these narrowings or stenoses is a marked discoloration. (Case 4.)

FIG. 9. Appearance of the bladder at operation. Cystiform protrusion seen on left side (retracted so as to show relation to right ureteral orifice and to internal meatus). (Case 5.)

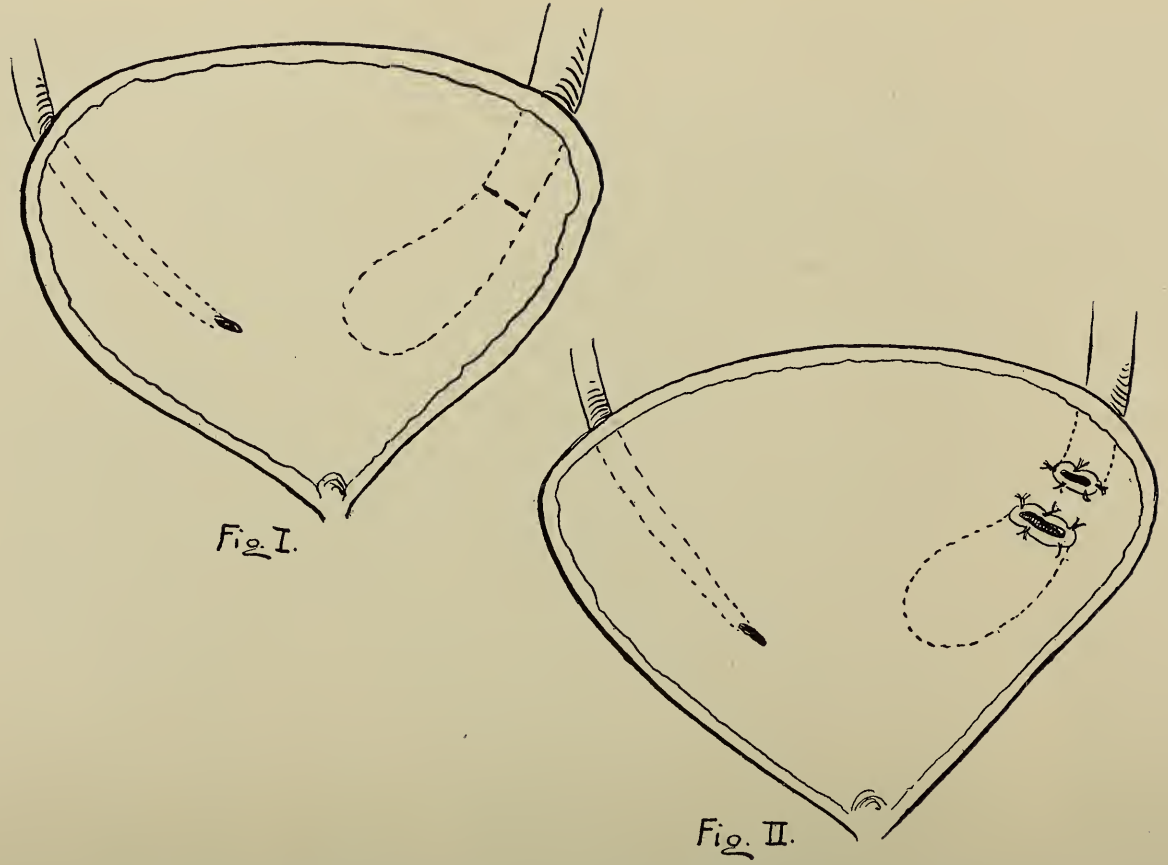


FIG. 10. Plastic operation to correct cystiform protrusion. I, course of both ureters before ureterostomy (note dilated lower end of left ureter). II, method of suturing the proximal and distal portions of the ureter into the bladder.

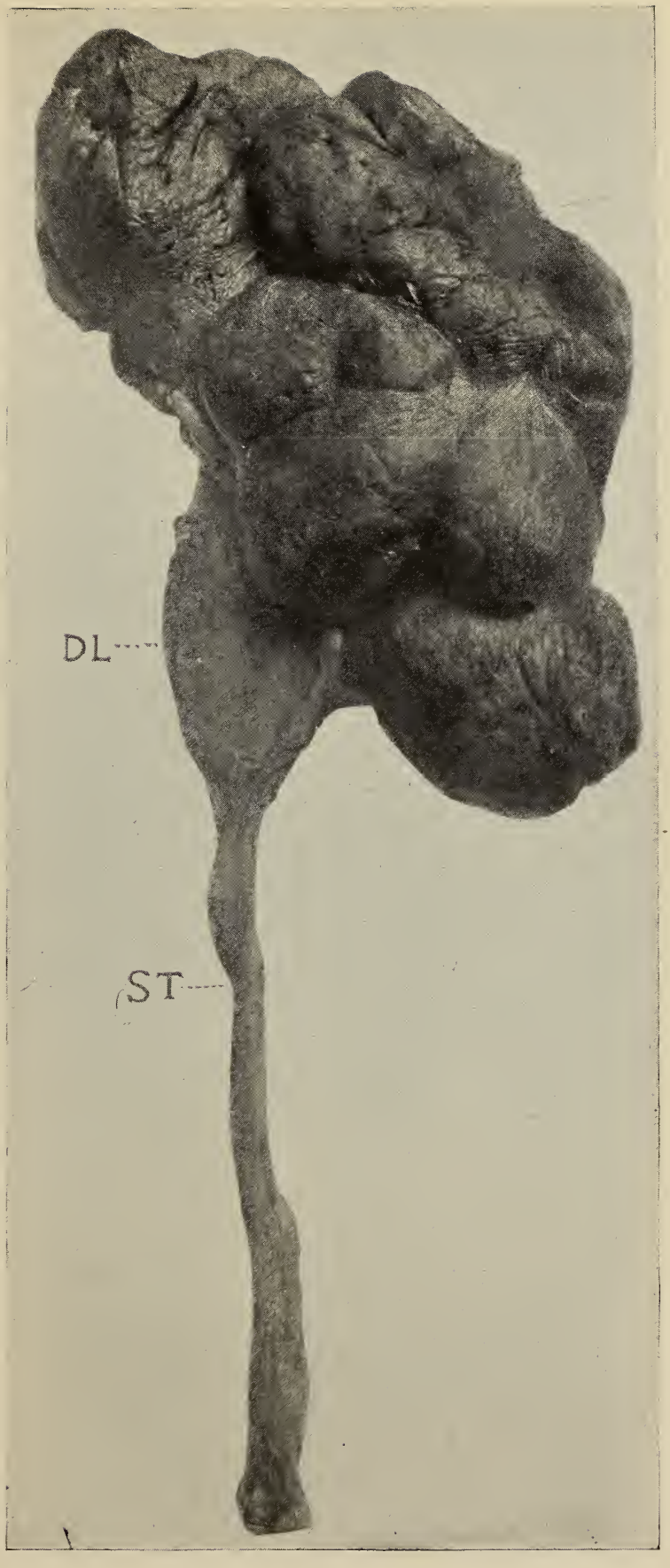


FIG. 11. Kidney from Case 5, showing spiral twist of ureter. *DL*, dilated ureter above the point of stenosis. *ST*, spiral twist in ureter, causing stenosis.

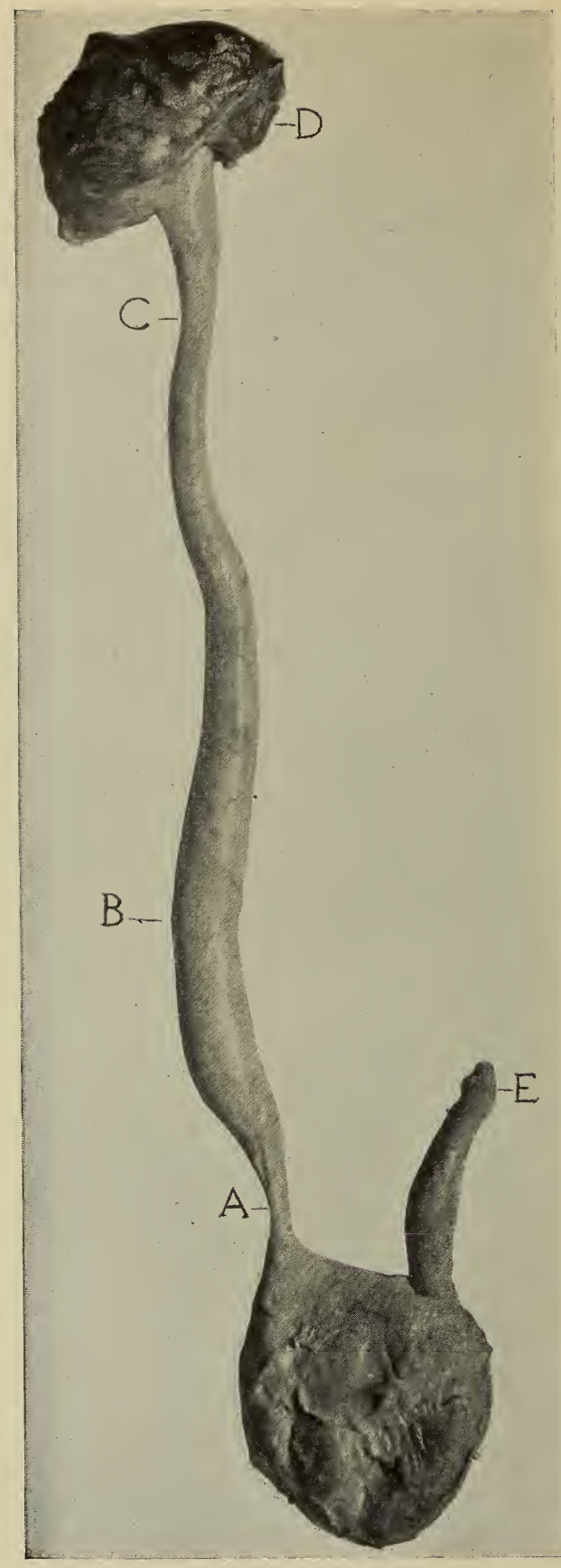
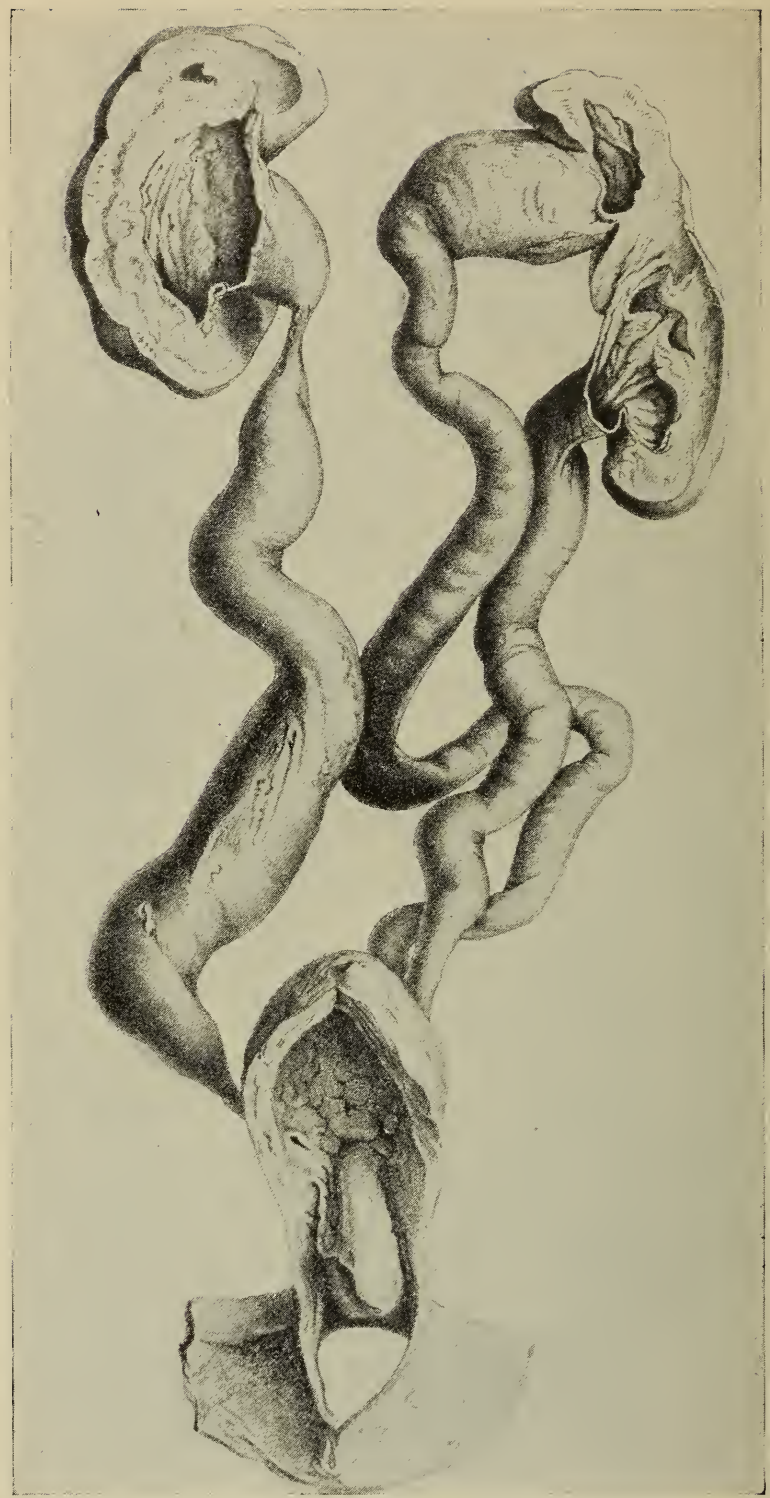


FIG. 12. Congenital stenosis of the ureter. (Case 5.) Note constrictions at *A* and *C*, and dilatation at *B*. *E* is the stump of the left ureter; *D*, right kidney.

FIG. 13. Right kidney, ureter and bladder (removed at autopsy of Case 5). Bladder opened to show patent ureterostomy (left), and dilated right ureter and kidney.



Case 14. Case showing protrusion into the bladder (Johnson's case). Right kidney enlarged, and its pelvis distended. Right ureter dilated and curving. Double ureters on left side, both dilated and tortuous. Protrusion extends from the left ureter into the urethral canal (see text).

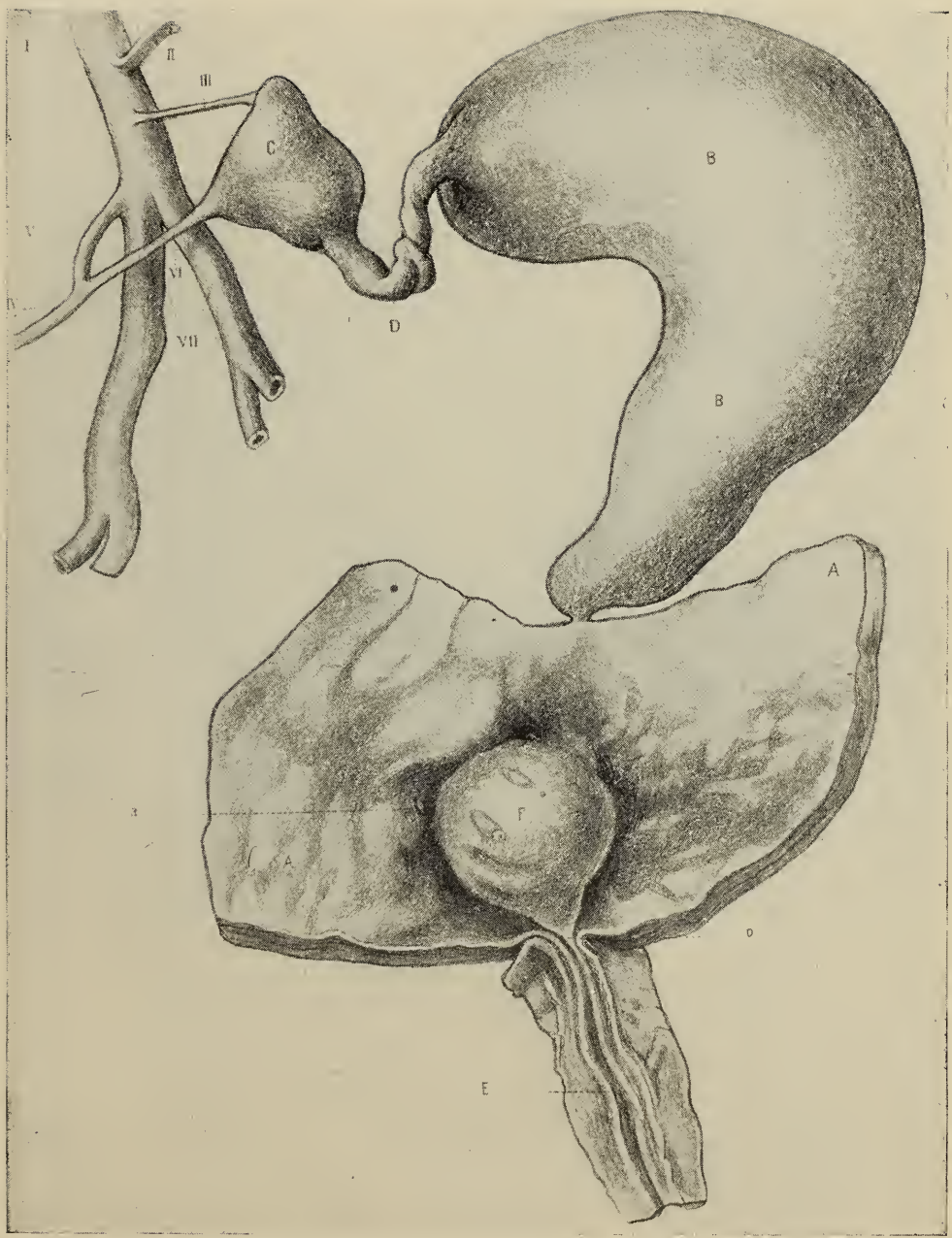


FIG. 15. Congenital closure of the left ureter, with protrusion of the closed vesical end into the bladder. Enormous dilatation of left ureter. Marked atrophy of left kidney. (Bostrom's case.)

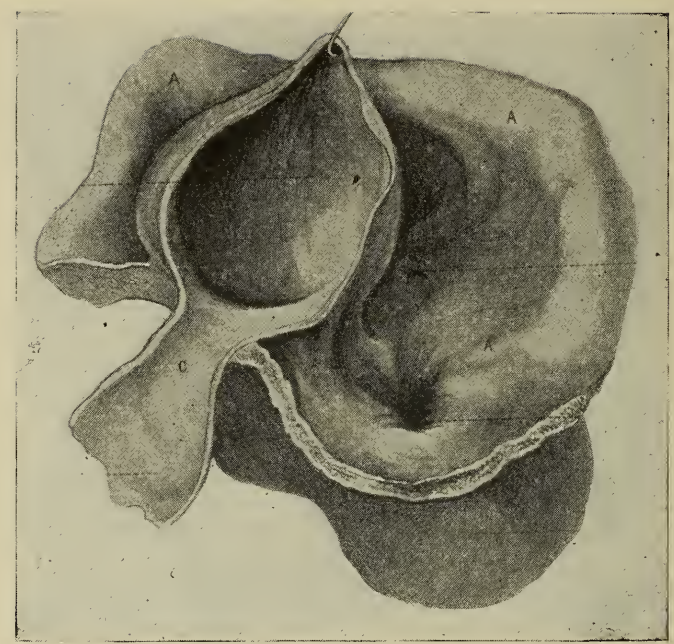


FIG. 16. Cystiform projection of the right ureter into the bladder. The ureter opens widely into the protrusion. (Bostrom's case.) (Type of Case 5.)

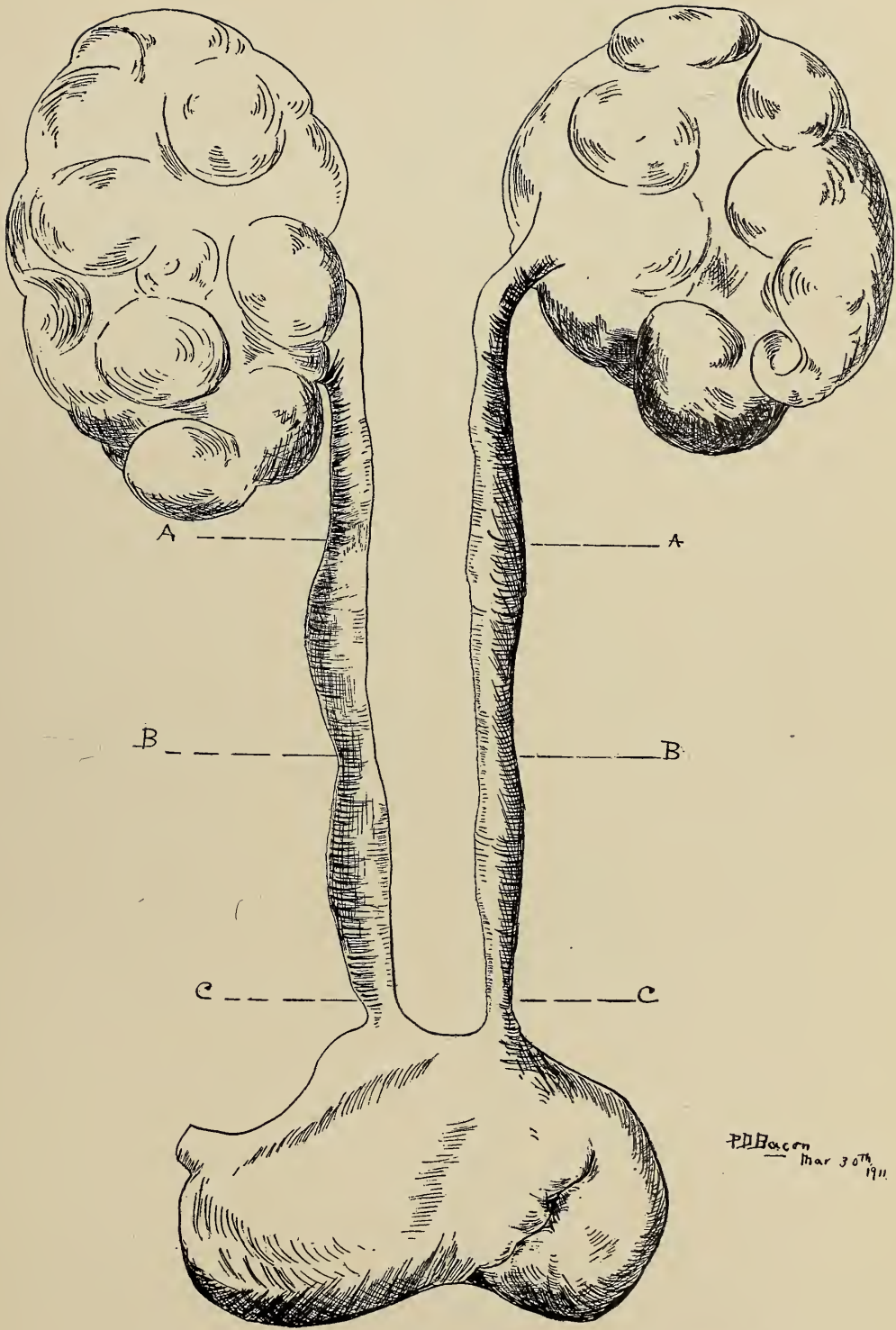


FIG. 17. Fetal ureters (Seitz) showing normal constrictions (*A*, *B*, and *C*) and normal dilatations on their proximal side.

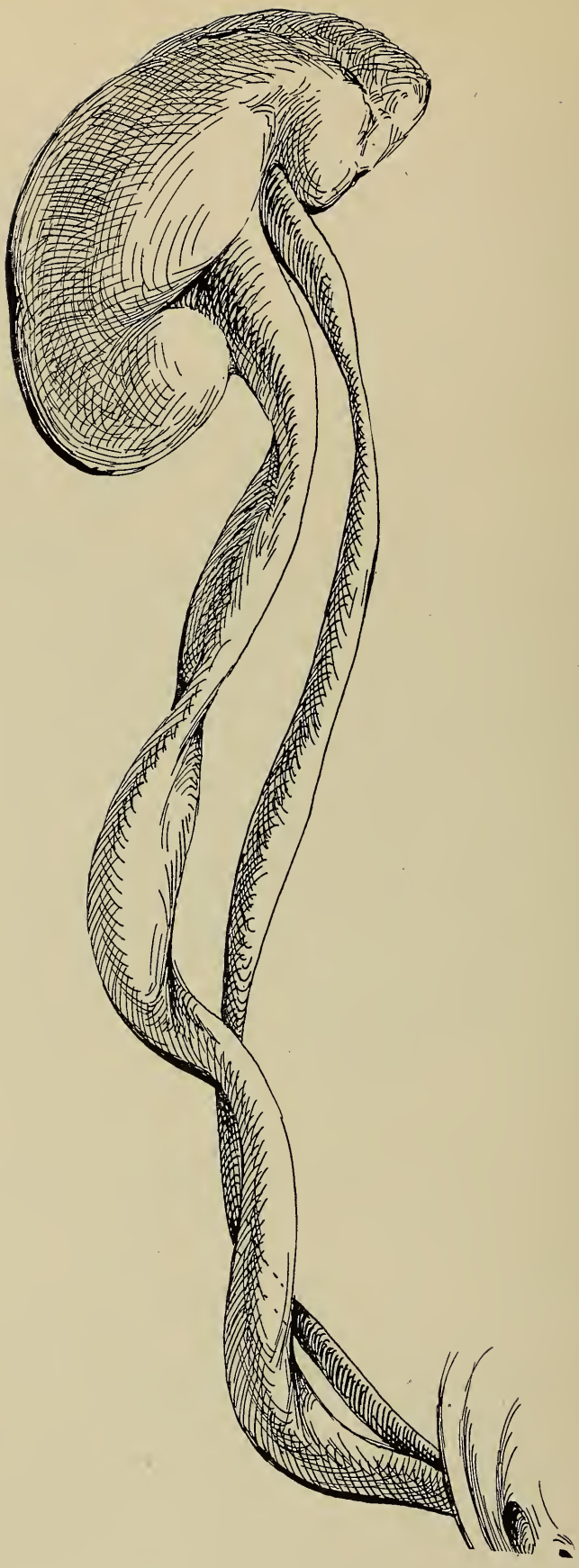


Fig. 18. Case of double ureters showing twists and dilatations. (Byron

FIG. 19. Sagittal section of the adult human ureter, showing spiral twists, constrictions, and valve-formation. (Byron Robinson.)

found edematous, as if the seat of a recent infection, and upon incision a slightly turbid serum escaped. No cultures were made. The ureter was dilated to the size of a small gut, with walls extremely thin and easily torn. Dilatation showed gradual narrowing at the junction with the renal pelvis above, and a quite sharp termination at the lower end, just below the brim of the true pelvis (Fig. 7). From this point downwards the ureter felt hard and fibrous, but allowed an ordinary ureteral catheter to pass through into the bladder. The ureter above this narrower pelvic portion was found to be of tissue-paper thinness, with markedly edematous and reddened mucous membrane. At about the middle of the enlargement two distinct mucous valves were seen, which did not cause any obstruction. The ureter at first drained, but recurrence of fever, which became quite high, necessitated removal of the dilated ureter and kidney. The ureter was distinctly narrowed at its junction with the renal pelvis. (Fig. 7.) There were marked evidences of a recent pyelonephritis, many groups of small abscesses being scattered over the renal cortex.

The patient made an uneventful recovery, and has remained well up to present time (eighteen months after operation).

Case 4.—Specimen of kidney, loaned by Dr. I. A. Abt.

The kidneys, ureter, and bladder from a child, ten days old, who had died of icterus neonatorum. The left ureter (Fig. 9) showed two distinct points at which its lumen was impermeable, even to the very smallest bougie. The proximal of these two strictures of the left ureter is one-half inch below the renal pelvis. The distal stricture of this left ureter is one-eighth of an inch above the bladder. A similar proximal stricture was found in the right ureter, five-

eighths of an inch below the ureteropelvic junction. There is no distal stricture of this left ureter. There is a marked spindle-like dilatation of the ureter, and renal pelvis (moderate hydronephrosis) on both the left and right sides above the proximal strictures. The following case was observed since the publication of the preceding ones.

CASE 5.—Girl of sixteen, but with physical and mental development of a child of six, was admitted to the service of Dr. I. A. Abt, in the Michael Reese Hospital. She had always been backward in intelligence and size, and showed all of the stigmata of cretinism. Her history was that of the sudden onset of severe pains in the abdomen, accompanied by frequent vomiting. This condition had lasted for about two weeks prior to her admission. The abdomen was enlarged and soft. There were tenderness and a feeling of resistance or of a mass over the right kidney, but nothing definite. No evidence of free fluid to be found. She was transferred to the surgical service of the writer, with the diagnosis of a probable right-kidney tumor. My examination, in addition to confirming the presence of marked retardation of mental and physical development, showed the presence of a suprapubic soft enlargement, which entirely obscured the possibility of palpating the tumor previously thought present by Dr. Abt. Owing to her irritability and the inability to reason with her, it was impossible to obtain any urine or to make a satisfactory abdominal examination until she was anesthetized. Upon inserting a catheter, a very large amount of turbid urine was evacuated, and the greater part of the suprapubic enlargement disappeared. Our suspicion entertained before anesthesia, that the suprapubic enlargement was due to a greatly distended bladder, seemed at first to be confirmed. But in spite of suprapubic pressure, the catheter being left in the

bladder, some enlargement remained, and I decided to open the abdomen in the median line and explore the peritoneal cavity. This was done and showed that both ureters were dilated, the left one far more than the right. The left ureter could be seen to be about the dimension of the adult thumb. The enlargement seemed to be uniform, i. e., it extended without any narrowing to the kidney above and to the bladder below. The corresponding (left) kidney was the size of the adult fist and markedly hydronephrotic, showing a number of translucent prominences corresponding to dilated calyces. The right ureter was about the size of a lead pencil, and much less translucent than the left one. The right kidney was only slightly hydronephrotic. No cause for the obstruction in the left ureter was found proximal to the bladder. The latter could still be felt to be considerably enlarged, so the first incision was closed and a second lower extraperitoneal one made, just above the pubes, and the bladder brought into the wound and opened. A very large quantity of turbid urine escaped. The walls of the bladder were greatly hypertrophied, and a projection into its lumen was to be distinctly seen on the left side (Fig. 9). It looked like an elevation of the bladder-wall covered by smooth mucosa, which seemed to fill up almost the entire bladder, projecting beyond the median line and anteriorly, so that it was necessary to hold it back with a retractor, in order to expose to view the right ureteral orifice and the internal meatus, both of which this prominence covered.

It looked not unlike the bulging of a rectocele, seen in a case of marked perineal tear. Examination of the right ureteral orifice and internal meatus showed that both were permeable in a normal manner. Most careful search was made for a left ureteral orifice, but none found. A diagnosis of cystiform protrusion of the lower end of a congenitally closed ureter was

made, and a plastic operation begun, so as to create a permanent left ureteral opening into the bladder.

The mucous membrane covering the cystiform protrusion was incised, and the greatly dilated ureter exposed. This was opened and divided transversely into a proximal and distal portion, the point of division being about one and a half inches above the lower end of the dilatation. The new ureteral openings were formed by uniting the mucous membrane of the bladder, as shown in Fig. 10, with the wall of the divided ureter. Although a probe was shown to have a wide range of movement in the distal portion of the cystiform protrusion of the ureter, no communication with the bladder-lumen was found. A case of Bostrom's, reproduced in Fig. 16, will give one the best idea of the condition, as found by us at operation. The ureter opened widely into the protrusion, and I thought it advisable to establish a permanent means of communication (Fig. 10) between the distal portion and the bladder-lumen, in order to permit of drainage of this distal pocket. It would, of course, have been ideal to make the new and only ureteral opening at the distal end of the dilatation, but it was impossible to find this end until we had made our incision through the posterior bladder-wall and opened the ureter at a point a little higher up.

This case, so far as I can learn, is the first one in which an intravesical ureterostomy was performed for congenital cystiform protrusion. That the opening remained perfectly patent was shown by the fact that it was found to admit a No. 5 English soft rubber catheter at the autopsy, held nearly four months after this ureterostomy operation.

The only manner in which I can explain the retention of urine, resulting in the suprapubic tumor felt before this first operation, is, that the cystiform protrusion, filled with urine, so filled up the bladder-lumen

as to obstruct not only the internal meatus, but also the right ureteral orifice. Before we could expose the right ureteral orifice, in order to determine its permeability to a catheter after opening the bladder, we were obliged to strongly retract the cystiform protrusion to the left. It is my opinion that the urine from this left kidney passed either by filtration into the bladder-lumen or through some minute opening which we did not find. It would seem reasonable to expect a very much more marked hydronephrosis on the left side, if none of the urine had escaped during the sixteen years of her life.

After this ureterostomy, on May 20, 1911, both laparotomy and suprapubic wounds healed very slowly. From May 20th until June 20th the temperature was practically normal, seldom rising as high as 100° F. Beginning June 20th, the temperature began to rise, reaching its first high point on June 26th (102.5° F.). From this date to July 20th, there were four febrile periods, lasting on an average from two to four days, with intervals of two to three days (see accompanying temperature chart).

The diagnosis of ascending infection of the left kidney was made, and an exploratory operation to determine the condition of this kidney was decided upon. This was performed on July 25, 1911. The kidney could be readily brought into the usual incision. Its cortex showed a very large number of deep hemorrhagic spots, and at the upper pole there were a number of pin-point yellowish pus foci. Both of these findings confirmed the diagnosis of a pyelonephritis. It was at first thought possible to save the kidneys by simply incising these pus foci, but, owing to the spiral twist of the ureter, described below, this was deemed inadvisable. It was found that the pelvis of the kidney was quite large, compared to the size of the kidney itself. This enlargement extended down

into the upper portion of the ureter, which was also greatly dilated down to a point about 4 cm. below the kidney. The shape of the enlargement was like that of the bowl of a pipe. The enlargement stopped suddenly at a point where the ureter seemed obstructed by a complete spiral twist of over 180 degrees (Fig. 11). There was a second spiral twist, about 3 cm. below this one. On account of the infected condition of the kidney and the difficulty of performing a plastic operation to join the ureter at a point below its second spiral twist with the pelvis of the kidney, it was deemed best to perform a nephrectomy. No accessory vessel which could cause obstruction of the renal pelvis, was found. The description of the removed kidney and removed ureter is as follows: The left kidney and ureter (No. 2,681) was removed July 25, 1911. It was 10 cm. long by 4½ cm. wide by 2 cm. thick. Fetal lobulations were well-marked. The cortex shows innumerable petechiæ at the upper pole, and there are a number of pin-point areas which, on section, are seen to be small pus foci in the cortex. Section shows the renal pelvis greatly dilated and a moderate degree of hydronephrosis. Pelvic mucous membrane is smooth and shiny, except for a few punctate hemorrhages. Dilatation of pelvis extends into upper portion of ureter for a distance of nearly 4 cm.

The ureter shows an enlargement extending to about 4 cm. below the kidney, resembling the bowl of a pipe, just distal to which is a peculiar twist in the ureter, spiral to the long axis of the ureter, so that when the ureter is placed in the position occupied in the body there is an almost complete closure of the ureter at this point, due to a spiral twist of nearly 180°. There is a second spiral twist in the ureter, about 2 cm. below the one described above, and a tendency to a third a similar distance lower down. From this point toward the bladder, the ureter is quite large, but shows no

twists. The ureteral walls are thickened. Upon inserting a probe from the lower end of ureter upward, one meets with obstruction at the above-described twists, especially the proximal one. (Fig. 11.)

POST-OPERATIVE NOTES

The kidney wound healed without complications. The patient, however, continued to look very pale, although passing a large quantity of urine, which, microscopically, showed a considerable number of pus corpuscles and traces of albumin. The microscopic examination of the tissue of the left kidney showed a high grade of chronic diffuse nephritis, with small focal areas of polymorphonuclear leucocytes. The patient continued to feel well, being up and about, and was shown in clinic a number of times. She was discharged from the hospital on October 15th, apparently greatly improved, but returned on October 21st, with symptoms of larygneal stenosis and pulmonary edema, due to uremia, with resultant general anasarca, and died on October 25, 1911.

The autopsy showed an absence of the thyroid, thus confirming our clinical diagnosis of cretinism. I shall add only the report of the autopsy, specimen of the right kidney, the right ureter, and the stump of the left ureter. (Figs. 12 and 13.)

The stump of the left ureter is two and a half inches long. From a point about one-quarter of an inch above its entrance into the bladder-wall it becomes dilated. The convexity of the dilatation is toward the left; in other words, it is not a symmetrical widening. The concave surface of the dilatation in this ureter faces the concave surface of the dilatation in the right ureter. The diameter of the dilated portion of this ureter at its widest point when filled with paraffin is almost one-half inch. (Figs. 12 and 13.) Where it becomes narrower, just before entrance into the blad-

der-wall, it is one inch in diameter. The description of the vesical orifices of this ureter will be found under the description of the bladder.

The right kidney shows no abnormalities in shape; the fetal lobulations are still quite marked. The true capsule is quite adherent, being almost impossible to strip. Distributed over the cortex of the kidney are a number of pin-point yellowish areas, which upon section are seen to be small collections of pus. A similar condition was found at the operation of July 25, 1911, in the left kidney which had been removed. In addition to these yellowish areas, the surface of the kidney shows a number of pale yellowish elevations. The surface resembles that of a chronic interstitial nephritis. On section of the parenchyma, considerable purulent fluid escaped from the pelvis and dilated ureter. The cut surface of the kidney shows that the pelvis of the kidney is greatly dilated at the expense of the parenchyma. The calyces are markedly dilated and contain a turbid yellowish fluid. The pelvic mucous membrane lining these dilated calyces shows intense injection of the blood-vessels, and in places there is a considerable velvety appearance of the mucosa, i. e., the typical picture of a chronic pyelitis. The parenchyma on section seemed to be present only to a small degree, its maximum width being one-quarter inch. The parenchyma, wherever present, showed marked glomerular injection. The right ureter showed a marked constriction close to the point of entrance to the bladder. This narrow point corresponds to that on the left side, about one-quarter inch in diameter, and extends about one-half inch in a vertical direction.

From this point upwards, for a distance of nearly four inches, occurs the first spindle-like dilatation of the right ureter. Just above this point the ureter again narrows and there is an incomplete spiral twist at this point. This is followed by a second spindle-like dila-

tation, which is shorter and ends about one and a half inches below the ureteropelvic junction. At this point there is a second less complete spiral twist.

Bladder.—The internal meatus readily admits a No. 5 soft-rubber catheter. The right ureteral orifice is distinctly visible, shows no abnormalites, and easily admits an ordinary probe. The left ureteral orifice corresponds to the point where the previous plastic operation had been performed. This readily admits a No. 5 soft-rubber catheter. Dissection of the bladder-wall for traces of a previous distal pouch corresponding to the lower end of the cystiform protrusion of the ureter, is negative. This is, in all probability, due to the fact that between the date of operation of the ureter and the date of dissection of the specimen, cicatricial contraction of this segment had caused complete obliteration of its lumen. There are absolutely no traces of any other ureteral orifice, which confirms the observation made at the first operation, that no left ureteral orifice could be found, the orifice being simply represented by a little dimple covered with mucous membrane. The bladder-walls show marked hypertrophy, as though great difficulty had been encountered in evacuating the urine.

REVIEW OF LITERATURE

In my previous article I expressed my indebtedness to Dr. John T. Bottomley for the painstaking manner in which he had collected all of the cases published up to the date of appearance of his article upon "Congenital Strictures of the Ureter," published in *The Annals of Surgery* for November, 1910. In order to better understand the nature of these congenital lesions of the ureter, I shall briefly review some of the chief points of my first paper.

Etiology.—This is not quite clear, but is best explained as either the result of the persistence of fetal

condition or a retardation of development of structures destined to perform important functions.

(a) Persistence of fetal conditions.

Seitz, Byron Robinson, Hamann, and others have shown by their studies of the normal ureter, in the fetus and at different periods of post-uterine life, that the ureter in all mammals possesses certain more or less constant points of narrowing and of dilatation. In addition, the occurrence of valves and of twists or tortuosities is not at all uncommon, especially in the fetal ureter. Figs. 17 and 18 show where these various conditions most frequently occur. The points of narrowing are as follows:

1. Just before the ureter enters the bladder wall. (C. in Fig. 17.)

2. Where the ureter crosses the pelvic brim. (B in Fig. 17.)

3. Close to the pelvis of the kidney. (A in Fig. 17.)

These three points of narrowing become more marked toward the end of fetal life, as Seitz has shown, and were constantly found in the normal adult ureter by Robinson.

The dilatations are always found on the proximal side of these narrowings in the normal human fetus. The most marked widening is situated in the middle third of the ureter, i. e., proximal to the narrowing which occurs at the pelvic brim or between it and the bladder-wall.

The spiral twists occur at any point, but are most marked at the junction of the upper and middle thirds of the ureter, as in the writer's Case 5. The rôle which valves play in the production of stenoses is not quite clear. They are found in about twenty per cent of cadavers of normal children, and contain mucous membrane, submucous and muscular tissue. In some cases the ureter is stenosed at the point where valves

are found, and in all probability the valves play a rôle here.

Clinical Importance.—The presence of narrowings, twists, and valves, as found in the normal fetal and adult ureter, was formerly thought to be of interest to the anatomist and pathologist alone. Although a number of the cases collected by Bottomley were reports of specimens found at autopsy, yet in quite a large number the persistence of these congenital conditions gave rise to symptoms requiring operative measures. We shall see later that there are many cases which remain latent throughout life, and, on the other hand, there are quite a number in which infection or the presence of a tumor caused symptoms which drew the clinician's attention to the case.

In several of the cases collected by Bottomley, a portion of the ureter was wholly fibrous, while in others the ureter was impermeable throughout and was represented only by a fibrous cord, i. e., a functionless ureter. Teyssédre[1] collected reports of eleven such cases. Such a fibrous ureter may lead to absence of the kidney or of the whole or a portion of the ureter. In eight cases of Bottomley's series the stricture was located in the upper third of the ureter, usually at or close to the opening into the renal pelvis.

In 36 of 56 cases the obstructions were in or very close to the bladder; 17 of Bottomley's cases had vesical protrusions, and 39 had not. Nichol's and Abt's cases (Fig. 8) showed a stricture both at the upper and at the lower ends of the same side. The same ureter may present alternating portions with and without a lumen.

The most important and, in their effects, the most far-reaching modifications of form are seen in the obstructions at the lower end of the ureter, as existed in my Case 5. In these the ureter usually reaches

the bladder, but in most instances ends there in a blind sac. This blind end may be (a) just beneath the mucous lining of the bladder, (b) may lie in the muscular layer of the bladder-wall, or (c) may just reach the outer wall. If the blind end is in the muscular layer, and one examines the bladder from within, there will either be no trace whatever of a ureteral opening or, in its place, will be seen a dimple, a shallow invagination of the mucous membrane.

The most interesting forms, however, have to do with the ureters ending just beneath the vesical mucous membrane, as in my Case 5. These produce a cyst-like protrusion of the mucous membrane into the vesical cavity. The protrusion ranges in size from that of a small pea to one completely filling the bladder-lumen. The smaller are usually hemispherical in shape; the larger are either triangular or finger-shaped. Sometimes they reach the vesical opening of the urethra, or they may pass varying distances along the course of the latter, and in women they may appear even at the external meatus. When empty, they are flat and flaccid; when full they are finger-like, pear-shaped, and tense, broader and thicker at the base, and gradually tapering and thinning in the direction of the tip. They vary in length from 0.5 cm. to 6.5 cm. The ureteral opening into these pouches may be bristle-like or may be an aperture 2 cm. in diameter. Usually (in 12 out of 17 cases) the protrusions are blind cul-de-sacs without an opening into the vesical cavity. In 5 cases there was a communication between the protrusions and the vesical cavity, almost invariably by minute openings at the tip or on the side of the former. The content of the protrusion is usually a clear fluid. It may vary considerably in color. Sometimes it is muddy or cloudy.

Effect on ureter.—When the obstruction is at the lower end, the ureter is almost invariably dilated, thin-

walled, and tortuous. It varies in size from that of a pencil to that of the small intestine (Fig. 7). It becomes widened and lengthened. Occasionally it is lobulated, and shows windings and twistings. (Figs. 11, 12, and 13.)

Effects on the renal pelvis and kidney.—Either an enormous hydronephrosis or a most marked primary atrophy may result from ureteral obstructions of the same location and character. Hydronephrosis of varying degree is the rule. It may show itself simply as a slight or a moderate distention of the pelvis, as in my Case 3, or it may present as an enormous cyst filling the whole abdominal cavity, with only remnants of the true kidney tissue in the cyst wall, as in Case 2. Infection produces its usual disastrous effects, and in some cases completely disorganized kidneys are found.

Effects on the bladder.—The cystiform protrusions into the bladder may cause marked secondary pathologic changes in the other ureter or in the other kidney, as in Case 5. The protrusion may block the opening of the healthy ureter. In other cases it may wholly obstruct the vesical opening of the urethra, give rise to a distended hypertrophied bladder, and set going the usual sequelæ of retention of urine. Both the right ureter and internal meatus were obstructed in the writer's Case 5.

Symptoms and diagnosis.—In Bottomley's series, 19 cases gave either subjective or objective symptoms. Many cases occurred in subjects too young to make complaints. Hydronephrosis of great size and protrusion filling the bladder may exist for years without symptoms, unless infection occurs.

Symptoms and diagnosis.—A survey of all of the published cases of congenital anomalies of the ureter shows that clinically they belong to one of four classes:

1. Those in which the condition remains latent throughout life and is an accidental finding at autopsy. The majority of the published cases belong to this class.

2. Those in which the presence of an abdominal tumor, which may or may not be diagnosed before operation as being of renal origin, are found when the abdomen is opened. My first and second cases belong to this class. In the first case the boy was thought to have an appendiceal abscess on account of the persistence of the septic symptoms and the prominence of a tumor in the right hypochondrium, which was found at operation to be a hydronephrosis of the right half of a horseshoe kidney. My second case was diagnosed before operation as being a renal tumor, and in all probability a hydronephrosis. The probable congenital origin of the hydronephrosis was also diagnosed before operation, on account of the age of the patient, namely, twelve years. The operation verified this diagnosis.

3. Cases in which the predominant symptoms are those of an abdominal infection. The clinical picture may resemble that of an acute infection of one of the intraperitoneal viscera, or it may point more directly to the kidney and ureter as the source of the symptoms of infection. My third case resembled a case of Bottomley's in presenting the picture of an intra-abdominal infection whose nature could not be accurately determined until operation. In my own Case 3 the symptoms had begun very acutely, with pain and rigidity in the left half of the abdomen, and only under anesthesia was it possible to palpate what would seem to be rather a characteristic finding in these cases when it is present. This was also present in Bottomley's case. This is the palpation of a sausage-shaped tumor extending from the costal arch towards the pelvis and tapering somewhat from above downwards. In cases

where one suspects a dilated ureter, and such a finding is present, one could easily confirm the diagnosis, if operative interference were not urgent, by filling the ureter with collargol solution and then taking an *x*-ray picture.

4. Those cases in which disturbances of micturition are the principal symptom. This consists either of increased frequence or retention. My fifth case belongs to this class. The principal symptom was a suprapubic enlargement, which was determined to be due only in part to a distended bladder. The catheterization in this case showed that there was still a tumor present, in spite of the evacuation of a considerable quantity of urine. In such a case, or wherever there is a history of increased frequency of micturition in children not due in all probability to any other cause, one should always bear in mind the possibility of a protrusion of the closed or almost closed lower end of the ureter into the bladder, what has been spoken of frequently in this article as a cystiform protrusion.

The examination of the urine is of little value, unless infection has supervened, and even then there is nothing specific to be found. In the second and fifth cases the urine contained a considerable number of pus corpuscles without any active evidences of infection.

I have noticed one striking feature, and that is that these children who have congenital lesions of the ureter and kidney do not seem to be as well developed as other children of the same age.

In no case thus far published, with the exception of my second case, was a diagnosis of congenital lesions of the ureter made before operation. I do not doubt, however, that, since the attention of surgeons has been directed to these malformations of the ureters by the articles of Bottomley and the writer, the condition will be more frequently recognized in the future. No doubt many cases will be recognized before operation, and

at least the possibility of the presence of a congenital malformation will be suspected when a hydronephrosis is found in children. Cystoscopic examination will, of course, show the presence of cystiform protrusion, and it will be impossible in such cases to enter the ureter on the side of this protrusion in many cases. When there is a ureteral opening present and the stenosis is higher up than the bladder, it may be possible in the future to distend the ureter with collargol and thus make a diagnosis from the radiographic examination.

Treatment.—The treatment depends, first, upon the degree of stenosis; second, upon the damage to the kidneys due to the ureteral obstruction, and, third, upon whether infection is present or not. In the latter class of cases nephrectomy, is, as a rule, the only method of treatment. If the kidney has not been too greatly damaged, it may be possible to perform a pyelo-ureteroplasty or to implant the ureter into the bladder from a point above the stenosis. Some work has been recently done toward making artificial ureters, and I had intended in my second case to attempt the implantation of the Fallopian tube from a dog, in order to make an artificial ureter, but this was impossible, on account of the presence of pyelonephritis on the side of the stenosis. Cases have been operated on by Drew, Dudley Allen, Whipple, Mayo, Nichols, Bottomley, and myself. Of Drew's cases, one was cured and the other relieved by pyelo-ureteroplasty, the congenital stricture being near the pelvis in both cases. It was my intention to perform an operation of this kind in my fifth case, but the infected condition of the kidney and the complete twist in the ureter seemed insurmountable obstacles. In cases operated on by Dudley Allen and Whipple, nephrostomy was performed in both cases, successfully in Whipple's case, but in Allen's case a pyelonephritis developed and the patient succumbed. Mayo's, Nichols', Bottomley's,

and my first three cases are the only ones in which successful removal of both cause and effect by nephrectomy was accomplished. In my fifth case the patient seemed to recover from the ureterostomy, but nephrectomy was later necessary, on account of the suspected condition of the kidney of the same side, and the coincident twist of the ureter, shown in Fig. 11.

There are no records of any cases of operation in cystiform protrusion of the lower end of the ureter, and the ureterostomy performed in my fifth case is, so far as I can learn, the first reported of an attempt to correct the dilatation of the lower end of the ureter in a congenital case. The autopsy in this case showed that the ureterostomy opening had remained patent, and had it not been that the ureter was again narrowed by the twist close to the renal pelvis I have no doubt but that recovery would have been a permanent one. For the first four weeks after operation the patient seemed to be in excellent condition. During the second four weeks the symptoms of infection due to pyelonephritis of the kidney of this side presented. Following her nephrectomy, two months after the ureterostomy she had apparently made an excellent recovery until the uremic symptoms suddenly appeared.

CONCLUSIONS

1. Congenital malformations of the ureters were formerly thought to be of interest only to the pathologist.

2. The surgical importance of these malformations is just beginning to be appreciated.

3. Four of my cases were found to give rise to clinical symptoms sufficient to require operation. The fifth case was a specimen obtained at autopsy.

4. The clinical picture in these cases varies. In some the abdominal tumor is the most prominent symptom. These are the cases which are generally

spoken of as congenital hydronephrosis, where the obstruction is close to the renal pelvis. A second clinical variety is that in which the sausage-shaped tumor extends from the costal arch downwards. A third variety is where a protrusion of the lower end of the ureter into the bladder exists. A fourth variety is where the clinical picture is that of a renal infection. Some of these cases may be very difficult to diagnose on account of their resemblance to other varieties of intra-abdominal infection.

5. The origin of all congenital malformations of the ureter is undoubtedly a persistence of fetal conditions. The principal varieties found at operation and autopsy are the following:

1. No lumen for the entire length.
2. Narrowing or localized absence of lumen.
   a. Ureteropelvic junction.
   b. Upper third alone.
   c. Both upper and lower thirds.
   d. At vesical end (cystiform protrusion).
3. Spiral twists, usually one or more.

4. In none of the cases was the lesion due to any accessory renal vessels or any extra-ureteral inflammatory process.

DISCUSSION

Dr. M. L. Harris (Chicago): We have had several papers read before this Association calling our attention to anomalies of development, and this is another illustration of certain anomalies which occur and which are sufficiently important to warrant our attention. Anomalies are so frequent that, in order to explain obscure cases, one must bear in mind not only the pathology which may affect the normal anatomy, but also the pathology which may affect anomalous conditions.

Another point which this particular paper shows us is that in anomalies affecting the urinary organs we are likely to find the condition bilateral, influencing very materially the question of operative treatment. Another point is that in children who develop imperfectly, one of the conditions which we

must bear in mind and examine for is anomalies of the urinary tract and imperfect elimination. Another point which I wish to bring out is that not all of these cases which are found in children, such as strictures of the ureters, are of congenital origin; many of them are of inflammatory origin, and are due to the transmission of infection from the intestine during intestinal disturbances in early childhood. I have operated on two such cases which had clear, unmistakable histories of infection from the intestinal tract. The point of involvement in the ureter bears out this view. We find strictures, as has been mentioned, first, at the upper part of the ureter at the pelvis, where we frequently get infection from the intestine, and, second, at the brim of the pelvis where the ureter is crossed by the sigmoid on the left side and is overlain by the cecum on the right side, at both of which points infection takes place.

Dr. William Jepson (Sioux City, Iowa): The subject of anomalies is a very important one. Anomalies present themselves from the time of birth until death, as regards the kidney. This is well shown in the case of a baby, four and a half months old, that came under my observation twelve years ago. The child was thought to be suffering from intestinal obstruction; the abdomen was greatly distended. I removed the urine by means of a grooved director which I had. The child had a cyst, and, upon exposing the same, after opening the abdomen, the peritoneum that evidently covered the kidney was found adherent to the abdominal wall. I incised that, and in the peritoneal cavity there was an encysted collection of fluid. Upon palpitation I found this large mass to be a cyst, the cyst wall communicating on the right side with what seemed to be the liver. I contemplated the removal of the cyst wall, as it seemed to be a part of it, but only after I had palpated the structures to ascertain whether that was true or not was I sure that it was not the condition. At the point where the cyst was, a small shelf of kidney existed. This was removed and the child recovered. The case undoubtedly belonged to that classification that Dr. Eisendrath presented as the first one, where the ureter was closed at its origin.

Dr. John P. Lord (Omaha, Neb.): Eight months ago a woman, aged fifty-two, an American, intelligent, a farmer's wife, came to me with an enormous tumor in the right side extending beyond the median line, apparently occupying three-fifths of the abdomen. She gave a history of having had this tumor for twenty years. On account of its long existence a

practitioner had diagnosed it as a dermoid. I suspected cystic kidney and such it proved to be,—a most enormous affair. The ureter presented multiple constrictions. It was removed at its entrance to the bladder. The patient made a good recovery. There was no semblance of any kidney tissue in the specimen. The fluid was simply that of an ordinary cyst. The question presented itself, how long may such a thing be carried without giving rise to symptoms? It had become so large as to be a source of mechanical disturbance, interfering with respiration, and on that account she sought relief. But the question arises whether it may not have been congenital, or might have arisen because of a kidney infection incident to childbirth. I favor the former view.

NITROUS OXIDE GAS AND OXYGEN ANESTHESIA

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The art—and it is an art—of administering anesthetics has made great progress in the last ten years. The time has gone by for the surgeon to pick up anyone at the last minute to give the anesthetic. Medical opinion now demands that an experienced, trained person shall be procured for that purpose, and, personally, I believe that that person should be a graduate in medicine.

A large number of ingenious methods of administration for the different anesthetics have been presented to the profession, and the surgeon now is almost embarrassed in trying to make a choice from the numerous methods at his disposal. Local anesthetics are used in the spinal canal, in the nerve-trunks, and in and around the tissues at the site of the operation. Chloroform is used with the open mask; or, in operation on babies around the mouth, as in a cleft palate, it is used on a small gauze sponge held in a dressing-forceps three or four inches away from the mouth. Or a current if air is forced through the chloroform by means of a rubber bulb and then conveyed to the patient by means of a tube held in one corner of the mouth. Ether is usually administered on a mask, but in work on the neck or mouth it may be administered through rubber tubes placed in the nasal passages, or perforated plugs that closely fit the nostrils, the rubber tubes or plugs being connected with a Y to a funnel con-

taining gauze on which ether is poured. Ether may also be administered through the rectum, or intravenously, or by intratracheal insufflation. And then we have the nitrous oxid gas and oxygen administered by means of a mask, or through rubber plugs that closely fit the nostrils and are connected with a Y to the administration apparatus. A method has also been recently developed by which gas and oxygen may be administered by intratracheal insufflation.

These are only a few of the many methods of producing anesthesia that have been ingeniously worked out and presented for the use of the surgeon and anesthetist.

It is now generally conceded that all anesthetics are more or less dangerous, and the shorter the operation and the anesthesia the better it is for the patient. Before the anesthetics had been discovered, operations had to be done without anesthesia, and the surgeon cultivated a dexterity that allowed the operation to be done quickly. After anesthetics had come into use, it was not considered necessary any longer to use any celerity in getting through with the operation. Everything was done leisurely, because the patient was not suffering any pain, and there was no need for haste. We now know that this was wrong and that every effort consistent with good and thorough work should be made to shorten the length of the anesthesia and lessen the dose of the anesthetic.

In the endeavor to lessen the amount of the anesthetic used there has arisen a custom of giving a hypodermic of morphine, or morphine in combination with atropine, hyoscine, or scopolamine, as a preliminary to the administration of the anesthetic. I have used a preliminary of morphine, $\frac{1}{6}$ grain, and scopolamine, $\frac{1}{100}$ grain, for several years on more than two thousand patients and have seen no bad results. It has

added greatly to the comfort of the patients by quieting all apprehension, has prevented the dangers of fright, and has decidedly lessened the amount of the anesthetic required.

The three anesthetics in general use are chloroform, ether, and nitrous oxide gas and oxygen. Dr. J. C. Bloodgood[1] said not long ago that any changes or improvements in anesthesia should look to the safety and comfort of the patient, but that the *safety* of the patient should always be considered before his *comfort.* We should be careful that anything we do to increase the comfort of the patient does not add to his danger. I think we will all agree to these principles. Therefore, it may prove interesting and profitable to study the advantages and disadvantages of each of the three general anesthetics with this thought in view.

CHLOROFORM

Advantages:

1. A small amount is required to produce anesthesia, and it is easy to carry around and handle; therefore, its use appeals to the general practitioner who travels long distances in the country.

2. It is not expensive.

3. The apparatus for administration is simple and inexpensive.

4. It is very convenient to use in obstetrical work, and when given only during the pains the danger seems to be very slight.

5. It produces great relaxation of the muscles and makes the operative work easier for the surgeon.

Disadvantages:

1. It exerts a harmful action on the heart, and the sudden deaths during its administration are usually due to its depressing action on the heart.

2. On account of the comparatively small amount required, it is easy to give an overdose.

3. It exerts a harmful action on the liver, sometimes causing acute fatty degeneration of the liver and death within a few days after its administration.

4. Subsequent administrations at frequent intervals are relatively a great deal more dangerous.

5. It has a sickening, sweetish odor that many patients dislike.

6. It produces a shock or depression of its own and thus contributes to the shock of the operation.

7. Its administration is frequently followed by protracted vomiting.

ETHER

Advantages:

1. It is easier to carry around than gas, but is a little more bulky than chhloroform.

2. The apparatus for administration is simple and inexpensive.

3. It is a little more expensive than chloroform on account of the greater amount required, but not so much so as gas.

4. It relaxes all the muscles nicely and makes the operative work easier for the surgeon.

Disadvantages:

1. It is irritating to the respiratory passages.

2. It is irritating to the kidneys.

3. It sometimes causes acute fatty degeneration of the liver-cells and death.

4. Subsequent administrations frequently repeated greatly increase its harmful effects.

5. It has an irritating, pungent odor that is very disagreeable to nearly every patient.

6. It has a deleterious influence on the leucocytes, which is harmful to patients with infections.

7. It produces a shock or depression of its own and thus contributes to the shock of the operation.

8. Its use is frequently followed by protracted vomiting.

NITROUS OXIDE GAS AND OXYGEN

Advantages:

1. It has no odor, and the patient is not aware, so far as any odor is concerned, that he is taking an anesthetic; therefore, he goes to sleep quietly and easily.

2. It produces no shock of itself, and the total amount of shock from an operation is much less under gas and oxygen than under ether.

3. It does not have any harmful action on the leucocytes, and therefore its use is indicated in infections.

4. Its danger is not increased by frequent subsequent administrations.

5. There is much less post-operative vomiting from gas and oxygen than from ether or chloroform.

Disadvantages:

1. It is considerably more expensive than ether or chloroform.

2. It does not produce the deep relaxation of the muscles that is seen under ether or chloroform anesthesia.

3. The anesthesia is much lighter and more transient and consequently requires more watchfulness and expertness on the part of the anesthetizer to produce an even, smooth anesthesia.

4. It requires a more expensive and more complicated apparatus for its administration, and the anesthetizer, or someone in charge of the apparatus, must have considerable mechanical ability in order to keep

the joints gas-tight and keep it in smooth working order.

An analysis of the disadvantages of gas and oxygen show that they concern the surgeon and anesthetist, but not the patient. The disadvantages of gas and oxygen do not add any discomfort or danger to the *patient.* Please note that.

Ether undoubtedly has an irritating effect on the kidneys. If this statement is doubted by anyone, all he has to do is to examine the urine of a few patients for three days after an ether anesthesia, and all doubt will be removed. A few years ago I did this, and the amount of granular and epithelial casts, blood-cells, and kidney-cells in the urine, as shown by the microscope, was one of the things that made me begin the preliminary use of scopolamine and morphine in the effort to lessen the amount of ether required.

Bevan and Faville[2] in their classical article showed conclusively the harmful effect of chloroform and ether on the liver-cells which caused death in some cases several days after the anesthesia.

We all know the irritating effects of ether on the respiratory system, which has caused a post-operative pneumonia a good many times. We have all learned the wisdom of postponing an operation temporarily if the patient has an acute bronchitis, and ether is to be the anesthetic.

Ether and chloroform have odors that are very disagreeable to nearly every patient. A patient who has been given an anesthesia of ether or chloroform does not want to smell the drug for a long time after the administration. The very smell makes him sick and recalls the disagreeable features of the anesthetic.

Ask those patients who have been given ether or chloroform what was the most disagreeable feature that they remember connected with the operation, or

what they would dread most in a future operation, and nine times out of ten they will tell you it is the anesthetic. After a gas and oxygen anesthesia, properly given, they do not dread a second anesthesia. We often administer gas and oxygen and drain an appendicular abscess or a pelvic abscess, and a few days later remove the appendix or tubes. The patient makes no protest about a second operation. We often have a patient ask for gas when a gauze drain is to be removed and we readily grant the request. At the time we were using ether we never had a request of that kind.

Gas produces no shock of itself. Dr. George W. Crile[3] claims there is only one-fourth of the shock from the same amount of trauma under gas-anesthesia that there is under ether. Take one of us here today in good health and anesthetize him with ether for fifteen minutes some morning, and he will not be able to do anything much the remainder of the day. I have been anesthetized with gas for fifteen minutes and have been down town attending to my business in an hour afterwards. Ether and chloroform undoubtedly have an after-depressing effect on the patient. This becomes a very important matter if the patient is already depressed by an infection, hemorrhage, or any other cause.

Graham[4] claims that ether has a deleterious influence on the leucocytes and therefore adds to the dangers of an infected patient. So far there has been no evidence that gas and oxygen has any such influence. Clinically, gas and oxygen is the choice of Murphy and other operators in suppurative peritonitis and other infectious diseases.

Any danger from gas is not increased by frequent administrations. Offergeld[5] and Mueller[6] pointed out several years ago that a second anesthesia of chloroform or ether following the first within two or three

days carries with it about twice as much danger. This is not true of gas and oxygen. We have given it repeatedly to the same patient without any ill effects. Dr. Willis D. Gatch[7] also claims that he has given gas repeatedly to the same patient without any ill effects.

There is practically no discomfort due to the anesthetic following a gas and oxygen anesthesia. The patient awakens quickly within a few minutes, bright and cheerful, without any depression. Once in awhile a patient will vomit once immediately after the anesthesia is ended, but there is no protracted vomiting, such as is seen, sometimes, after an ether anesthesia.

As to the disadvantages of gas, its cost makes it almost prohibitive for the slow operator who requires one and one-half hours for an appendectomy, or three hours for an ordinary hysterectomy. Gas is not the anesthetic for the operator doing "chronic surgery." The expense may be lessened by allowing the patient to rebreathe the gas and oxygen as suggested by Dr. Gatch[7]. The rebreathing does not seem to harm the patient, and greatly lessens the amount of gas consumed. Where the gas is used in quantities sufficiently large to justify the initial expense of the plant, the cost can be still farther lessened by putting in a hospital the apparatus for its manufacture.

I have had such an apparatus installed in the St. Francis Hospital in Peoria. The gas is made and stored under pressure in a steel tank. It is admitted through a metal pipe to the operating-room at an even pressure of twenty-five pounds by means of an equalizing gauge. This has been found by experience to be the best pressure for the administration of the gas, but the pressure may be varied at the equalizing gauge to suit the ideas of the anesthetist. The oxygen may be procured cheaper than it can be manufactured at the hospital. It comes in large tanks holding 1,250 gallons, and can be bought for about one-half cent a gallon.

It is delivered to the operating-room by an equalizing gauge at about ten pounds pressure.

I use the Teter administration apparatus. The gas and oxygen goes from the mixing chamber through several coils of small pipe immersed in water which is heated by an alcohol lamp enclosed in a miner's safety device. The miner's safety device prevents any possible ignition of ether vapor from the alcohol lamp. The warm gas then goes through a rubber tube to the inhalation-mask. The Teter apparatus also has an ether-container, and varying proportions of the warm gas may be passed over the ether, if desired, by a system of cocks. The boiling-point of ether is so low, being about 96°, that the warm gas takes it up readily. Any proportion of oxygen may be mixed with the nitrous oxide gas in this apparatus, or any proportion of ether may be added to the mixture that the anesthetist desires.

As to the second objection, that gas does not relax the muscles, the only difficulty encountered is in operations involving the recti muscles, and the leg muscles in operations in the lithotomy position. In elderly women who have borne children the recti muscles relax nicely under gas and oxygen, and in old people of both sexes the leg muscles relax nicely in the lithotomy position. All of my perineal prostatectomies are done under gas and oxygen exclusively.

If there are no conditions in the patient contra-indicating the use of a small amount of ether, such as bronchitis or a nephritis, and an operation is necessary involving the separation of the recti muscles or the lithotomy position, such as removal of hemorrhoids, gas is administered until the patient is asleep. Gas has no odor, so the patient has no disagreeable sensations on going to sleep to recall after the anesthesia is over. After the patient is asleep, a cock is turned which switches the current of warm gas so that it passes

over the ether. About two or three drachms of ether is added to the mixture in this way. This produces the necessary relaxation of the muscles, and the gas is then turned off from the ether. The gas will hold the relaxation during the remainder of the anesthesia.

If there is any contra-indication to the ether, any operation may be done under gas and oxygen alone, but it makes more difficulties for the operator and involves more use of retractors. The most difficult operation to do under gas and oxygen anesthesia is the removal of hemorrhoids in a young man. Hernias, appendectomies through the McBurney incision, drainage of empyemas of the chest, drainage of appendicular and other abscesses, amputation of breasts, goiter and other neck work, operations on the extremities, in fact all operative work, except abdominal and pelvic work where the incision is through or between the recti muscles, and operations requiring the lithotomy position, may be done just as easily under gas and oxygen as under ether. Operations coming under the two exceptions may be done readily under gas and oxygen, but not so easily as under ether.

The third objection to gas should not carry much weight. It requires more watchfulness and experience and expertness on the part of the anesthetist, it is true. The surgeon cannot pick up anyone to administer gas to his patient; but he should not do this, anyway. The very fact that the anesthetist who administers gas must watch his patient closely to keep him smoothly under it, makes me like the gas that much more.

It has been my experience that patients will more readily consent to operative work if "laughing gas" is to be the anesthetic. I cannot entirely explain the psychology of this, but I have concluded that gas is associated in their minds with extraction of teeth and minor surgery. Therefore, an anesthesia of "laughing gas" unconsciously lessens their sense of the grav-

ity of the operation. It is a fact that I have operated on old people who had carried tumors and gall-stones for years and had steadfastly refused surgery until they heard that I was using "laughing gas." Then they consented to come in.

To recapitulate: The patient is given scopolamine, $\frac{1}{100}$ grain, and morphine, $\frac{1}{6}$ grain, about one and one-half hours before the anesthesia is begun. This is a beneficent measure that adds greatly to the comfort of the patient by relieving all apprehension and fear, and in my experience has not added anything to the dangers of the anesthesia.

The anesthesia is begun with nitrous oxide gas and oxygen and is continued with it to the close of the operation, unless the incision is made through or between the recti muscles or the operation requires the lithotomy position.

In patients where the incision involves the recti muscles or requires the lithotomy position, and the recti muscles or the leg muscles do not relax under the gas and oxygen, a little ether (two to four drachms) is added until these muscles are relaxed, and then the anesthesia is continued under gas and oxygen exclusively. If one of these patients has any disease of the liver, kidneys, or lungs, including the bronchial tubes, the entire operation is done under nitrous oxide gas and oxygen exclusively, no ether being given. Giving no ether makes the work more difficult for the operator, but it is considered safer for the patient.

If, at any time during the anesthesia, the anesthetist feels that the patient's heart needs the stimulating effect of ether, and there are no contra-indications, he can mix ether with the gas and oxygen by switching some of the warm gas through the ether-container. The apparatus is flexible, and varying proportions of gas, oxygen, and ether may be used to suit the requirements of the individual patient. In this way the anes-

thetics are fitted to the patient; and not the patients to one anesthetic.

While many surgeons may not care to use gas and oxygen for practically all surgical work as a few of us are doing, the fact still remains that nitrous oxide gas and oxygen is the safest and best anesthetic for all minor surgery, for operations during surgical infections, for operations where shock is present or likely to be caused, for operations on patients who have a bronchitis or a nephritis, and for patients who require more than one anesthesia within a few days. Is it too much, then, to say that an apparatus for the administration of nitrous oxide gas and oxygen is one of the *requirements* of modern surgery?

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FOR DISCUSSION SEE PAGE 269

AN EXPERIMENTAL STUDY OF SOME EFFECTS OF CERTAIN ANESTHETICS

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This work was undertaken with the knowledge that in no other way could we obtain satisfactorily accurate information as to the somatic effects of anesthetics, and in the hope that thus might be made possible for us the comprehension of principles underlying the clinical application of rational methods of anesthesia.

Problem.—It was assumed that ideal anesthesia demands the least discomfort with the greatest immediate and remote safety, mental and physical. The experiments here reported were designed to establish the effects of certain anesthetics upon certain organs and also the results of these effects upon the resistance of the organs to toxins.

Methods.—Rabbits were used, but only because they were the least unsatisfactory of available animals. Every possible care was exercised to select approximately the same sized animals (2 to 3 kilo) under similar conditions.

Anesthetics.—Chloroform, ether, and nitrous oxide and oxygen were given to three series, respectively, for a period of forty-five minutes. The anesthesia was maintained at a depth which would give a relaxation in the animal, simulating as nearly as possible that required in human surgery. The same professional

anesthetist invariably conducted the administrations. Morphine sulph., gr. 1/6, and hyoscine hydrobrom., gr. 1/100, were given hypodermically to a separate series.

Toxin.—Cobra venom was selected because of its containing a narcotizing principle sufficiently potent to minimize discomfort and because of its stability and safety.*

A maximal non-lethal dose was determined (0,000,275 gm. per kilo), but later was found to be too large for animals living under winter conditions. No attempt at a reduction was made then, as it would have vitiated comparison with many experiments already performed. In addition, the venom, because of its destructive action upon the respiratory center, was ill chosen. For evident reasons, experimental observations, to be applicable to clinical conditions, must be based upon results obtained through action of toxins developed *in vivo* by living bacteria.

Conditions.—The effect of each drug was studied under these conditions. In Group 1 the anesthetic or narcotic was given for forty-five minutes, and then the venom was injected intravenously; in Group 2 the anesthetic was started and the venom injected as promptly as possible; in Group 3 the venom was injected, and forty-five minutes later the anesthetic was begun and continued for forty-five minutes.

Observations.—Effects upon the blood-pressure, hemoglobin, leucocytes, and temperature were observed at similar intervals. When the experiments were lethal, necropsies were done as promptly as possible, gross changes noted, and blocks of tissue from the heart, lung, liver, spleen, kidney, thyroid, thymus, and adrenal were placed in formalin for section.

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*The venom was obtained through the generosity of Prof. Kyes of the Department of Experimental Pathology, University of Chicago.

Controls.—Similar observations were made when animals had been subjected to the action of venom alone in lethal and non-lethal doses, and of the various drugs alone when given with fatal results and when animals were killed at intervals by *coup de main* for purpose of comparison.

All of the material for histological study was collected in similar bottles, separately numbered, and sent to the Department of Pathology, University of Wisconsin. Here the microscopic preparations were made, and the pathological reports were written by Professor Bunting while in ignorance of what had been done. This guarantees that these observations were purely objective. Mr. M. Smith-Petersen, of the Department of Physiology, University of Wisconsin, made the blood-pressure observations partly in Madison and partly at the Columbia Hospital. Dr. W. L. LeCron, resident physician at Columbia Hospital, made many of the blood-counts on the rabbits and all of the clinical observations. Miss S. S. Mathews, R. N., administered the anesthetics so carefully and conscientiously that direct comparisons are probably justified.

Blood-pressure.—Anesthetics and narcotics administered to rabbits in dosage compatible with recovery induce a slight fall in blood-pressure (4-16 mm.) over a period from three-quarters to two and three-quarters hours. Similar results follow non-lethal doses of cobra venom.

When the venom is administered in lethal dosage the blood-pressure may fall abruptly just preceding death or, more gradually, quite in keeping with the animals' behavior, a sudden collapse or gradual wilting.

These observations seem to apply to animals receiving both toxin and anesthetics.

Nature of death.—Where a fatal issue resulted from venom alone it was typically that of respiratory center failure. When, in addition a drug had been administered the typical picture was so little modified that it was quite impossible to determine, either by the character of the death or the gross post-mortem appearance, which factor had been the more active in the causal relationship. Indeed, animals dying from anesthetics alone, but after the administration had been discontinued, evidenced nothing so characteristic as to permit a certain diagnosis based upon the nature of the death itself; therefore, as it was impossible to differentiate accurately between a venom death and an anesthetic death, all fatalities were included in the records, even when it became evident that the venom dose was no longer non-lethal. Since the respiratory center, and possibly the vasomotor center, was so deeply affected by the venom in these experiments, too great importance should not be attached to the mortality. These series of animals were subjected to a degree of intoxication which, if present in the human, might render surgical intervention unjustifiable—a mortality of 25 per cent increased to 60 per cent by anesthesia or narcosis alone.

The results of the various series comprising Group 1 are shown in Table 1. The average length of life indicates the interval between the injection of venom and death. The average leucocytes indicates the extent of gain (+) or (—) in the white blood cell count, comparing the normal count for the animal with those taken at one-hour to two-hour intervals after the administration of the drug or toxin or to that made immediately, ante-mortem, in the animals dying acutely. Hemoglobin estimations, because of complicating cyanosis, proved entirely unreliable.

The average temperature indicates in degrees the loss sustained at periods corresponding with the white-blood counts.

TABLE 1, GROUP 1.

Venom injected immediately after drug administration for 45m.

	Mortality per cent	Average length life	Average leucocyte	Av. temperature
Chloroform	40	0:45	—1,220	—1.8
Ether	25	4:30	+1,175	—3.9
Gas and Oxygen...	75	1:45	+3,050	—1.3
Morph. & Hyoscin	20	29:00	+12,900	—2.0
Group Average	40	12:00	+3,926	—2.3

An impression, perhaps erroneous, was gained during the conduct of the experiments that generally the animals showing increasing leucocyte counts and less loss in temperature were the more likely to recover. This is somewhat obscured in the tables because certain animals developed a hyperleucocytosis before death.

Table 2 shows the results in the second group. Miss Mathews noted in this class of experiments that during the forty-five minutes of anesthesia the action of the venom seemed to be held in abeyance, but almost cumulative effects were noted after the administration was ended.

TABLE 2, GROUP 2.

Drugs and venom administered simultaneously.

	Mortality per cent	Average length life	Average leucocyte	Av. temperature
Chloroform	100	0:49	—4,080	—3.2
Ether	60	0:43	—2,550	— ?
Gas and Oxygen ..	71	2:28	+4,857	—1.6
Morph. & Hyoscin	75	1:21	+8,000	—1.9
Group Average....	77	1:20	+1,557	—2.2

Table 3 presents the results noted in Group 3. In this class the anesthetics were taken more easily, and less was required to produce the desired depth of anesthesia because of the narcotic principle in the venom. It is therefore entirely possible that these animals actually absorbed less anesthetic to produce the same degree of relaxation, though the records do not show a material difference in the amount of ether and chloroform administered.

TABLE 3, GROUP 3.
Drugs given 45 minutes after injection of venom.

	Mortality per cent	Average length life	Average leucocyte	Av. temperature
Chloroform	50	3:00	+3,400	—2.6
Ether	50	1:13	—5,100	—2.3
Gas and Oxygen...	50	3:10	—3,100	—2.8
Morph. & Hyoscin	100	1:43	+1,000	—3.0
Group Average	63	2:17	—800	—2.7

If the assumption is correct that death was caused principally by destruction of the respiratory center, a comparison of these three tables apparently indicates that the anesthetics, including the narcotics, are less injurious to a subsequent than to a preceding and most injurious to a concomitant profound intoxication, rapidly induced.

Table 4 presents a summary of all the experiments shown in Tables 1, 2, and 3. Rabbits succumb to chloroform very easily, take gas poorly, and were given a large dose of morphine and hyoscine, facts to be remembered in studying the table.

TABLE 4.

	No. experiments...	No. deaths.....	Mortality per cent	Av. length life fatal cases	Av. leucocytes all cases	Av. leucocytes fatal cases	Av. temperature all cases	Av. temperature fatal cases .....
Chloroform..	14	10	71	1:31	—630	—2,325	—2.5	—2.8
Ether	13	6	46	2:09	—2,159	+350	—3.1	—2.7
Gas & Oxyg.	15	9	60	2:28	+1,602	—489	—1.9	—1.7
Morph. & Hy.	13	8	61	10:35	+7,233	+17,800	—2.3	—3.4
Av. all Grp..	55	33	60	4:11	+1,511	+3,834	—2.5	—2.7

The behavior of the leucocytes under such conditions could have relatively little influence upon the resistance to the toxin; however, the development of a leucocytosis under clinical conditions is not to be regarded as unfavorable. None of the drugs used had a constant effect in this way, though gas and oxygen and morphine and hyoscine combinations were fairly frequently followed even in forty-five minutes by a substantial increase.

Pathology.—Venom: These animals lived an average of forty minutes after injection. At immediate

necropsy the only constant feature noted was a tremendous venous congestion under high pressure. Hemoglobinuria was inconstant.

The composite microscopic findings were as follows:

Heart: Congestion and occasionally edema, swelling, vacuolization, granular and hyaline degeneration of fibres, and some focal necroses.

Lung: Congestion, otherwise fairly normal; some atalectasis and emphysema, and occasional hemorrhages. Leucocytes fairly numerous intravascularly.

Spleen: Congestion, main characteristic frequently evidence of recent blood-destruction. Presence of many leucocytes in pulp.

Liver: Congestion. Cells constantly swollen, often granular or present a washed-out appearance, possibly a serous imbibition.

Kidney: Congestion, cloudy swelling constant, epithelium, especially the tubular, commonly ragged. Focal necroses and hemorrhages fairly frequent; also casts and evidence of hemolysis in tubules.

Thyroid: No change of importance noted.

Thymus: No change of importance noted.

Adrenal: No change of importance noted.

These pathological findings are given in detail because they are virtually those noted as the result of the administration of the drugs under consideration. In the following table, No. 5, is shown the *additional* effects of drugs alone given to two series of animals:

(A) those killed by *coup de main* immediately after a forty-five minute administration, and (B) those similarly killed on the fifteenth day after fourteen daily administrations of thirty minutes. Where no notations appear the histological findings were not especially characteristic and except for the congestion quite the same as indicated above in the venom series. At necropsy less venous congestion appeared than noted in those dead from venom.

TABLE 5.

Effects of single (A) and repeated (B) administrations of drugs.

		Chloroform	Ether	Gas and Oxygen.	Morph. & Hyosc.
Heart	A	.....	**		Congestion, Fibrillar degeneration esp. marked. Pre-existing chronic changes.
	B	Edema. Segmenta-Segmentation. tion. Fragmenta- tion.*			Edema, hemorrhages. Advanced degeneration. Focal necroses.
Lung	A	.....			Few leucocytes in vessels.
	B	* Many leucocytes intravascular.	Many leucocytes intravascular.		Congestion. Slight Hemorrhages.
Spleen	A	Acute sp. tumor. Few leucocytes.			Many leucocytes.
	B	Chronic sp. tumor. Many leuc. in pulp.	Hyperplastic sp. tumor. Many leucocytes.		Hyperplastic sp. tumor. Many leucocytes.
Liver	A	Cells esp. constant & mid-zone swollen & pale.	Cells swollen and pale.	Cloudy swelling. Congestion.	Cloudy swelling. Congestion.
	B	Cells esp. constant. Very much swollen & pale.	Cells swollen and pale.	Cloudy swelling. Congestion.	Cells extremely swollen and pale.
Kidney	A	Ep. desquamation hemorrhage casts.	Ep. desquamation. Casts.	Ep. desquamation. Casts.	Ep. desq. Marked necroses hem. casts.
	B	Ep. degeneration. Congestion.*	Ep. disentegration. Few casts.	Cloudy swelling. Numerous casts.	Tubules and granular capsules dilated. Ep. disintegration. Necroses casts.
Adr. Thyr. Thym.	A	.....			
	B	.....			

*Unless rabbits were kept continually actually in the open air they did not survive beyond two or three administrations of chloroform. Animals which succumbed after being kept in-doors, even when cages were near an open window, showed in lungs edema, hemorrhages, and a noticeable low intravascular leucocyte content; in their livers were foci of necroses and of hemorrhages, and the kidneys presented fatty degeneration and casts in excess. All of these changes were noted to some extent in the other animals.

**Three rabbits died directly as the result of gas anesthesia. All had chronic myocarditis.

Summary.—In addition to the average changes produced by venom already outlined, the drugs in single and repeated administrations caused noteworthy lesions. The remarkable susceptibility of liver and kidney to toxic action of even physiological doses is particularly striking.

Heart: Morphine and hyoscine in a single dose seemed to cause unusually severe changes; in repeated doses chloroform induced segmentation, fragmentation, and edema; morphine and hyoscine induced edema, hemorrhages, and focal necroses; ether induced segmentation. Quite unexpectedly, in view of its disastrous functional effect upon chronic myocarditis, nitrous oxide produced the least histological changes.

Lungs: Inconsequential.

Spleen: Repeated administrations invariably produced an hyperplastic spleen tumor.

Liver: Single administrations of chloroform and ether caused, particularly in cells of the central and mid zones, a swollen washed-out appearance, possibly indicative of serous imbibition. Similar but more pronounced alterations occurred after repeated anesthesia. Morphine and hyoscine and nitrous oxide produced, under similar conditions, cloudy swelling and congestion, possibly more severe after the morphine combination.

Kidney: The damage done to renal epithelium was both unmistakable and constant. Consequent functional derangement and permanency of these lesions can only be surmised. Chloroform and morphine apparently induce the more severe effects.

Adrenals, thymus, thyroid: Changes in these organs occur, but so inconstantly and in so little evident relationship to the experiments that their consideration is omitted.

The changes induced by the combined administration of venom and drugs is shown in Table 6. It is

perhaps remarkable that, under the conditions of profound intoxication and when the average length of life was but four hours, there should be any recognizable variations. Therefore the decided although slight increase in the severity of the lesions over those following drugs or venom alone, is to be regarded as of considerable significance.

TABLE 6.

Venom and Drugs combined. Average changes observed.

	Chloroform	Ether	Gas	Morph. & Hyocine.
Heart	Edema not mentioned. Tendency to focal degeneration.	Edema occasionally. Tendency to atrophy.	Edema the rule. Fibrillar disintegration the exception.	Edema constant, cellular infiltration more noticeable.
Lung	Fairly high intravascular leucocyte content.	Same.	Same.	Same.
Spleen	Congestion passive; occasionally free hemoglobin.	Same. Many leucocytes in pulp.	Same.	Same.
Liver	Central and midzone cells washed out, some fatty degeneration.	Same	but similar, less fatty degeneration.	Like gas.
Kidney	Parenchymatous degeneration constant. Epithelial disintegration.	Similar but less intense.	Same.	Same but possibly more marked changes than gas and ether.
Adrenals Thymus Thyroid	Evidently nothing significant.	Same.	Same.	Same.

Summary—

Heart: Chloroform showed no, and ether but slight, tendency to edema, which was noted more commonly in gas constantly in morphine and hyoscine; but both chloroform and ether show a far greater tendency to produce degeneration in the muscle fibers. Sherrington has indicated how rapidly heart-muscles take up chloroform.

Lungs: Virtually no individually characteristic changes were noted.

Spleen: Congestion, passive, was the rule in all.

Liver: Cells in mid zones washed out (serous imbibition) and at times fatty degeneration, especially in mid zone. These features most marked after ether and chloroform.

Kidney: Parenchymatous degeneration, amounting to epithelial disintegration, especially in the tubules, usually with casts, were the constant findings, but were more pronounced after chloroform and ether.

Leucocytes: Rabbits.—Morphine and hyoscine often exerts a positive chemotaxis for leucocytes. The response appears most promptly and unmistakably in normal animals (av. 12,700); less so when intoxication is established at the time of injection of drugs (av. 8,000); still less so when the toxin had been injected a short time previously (av. 1,000); and least when the intoxication occurs the day before, when an immediate loss (av. 870) occurs, but is followed in two to five hours by a sudden rise (av. 2,100) to or above the pre-injection number. A distinctly more sluggish response.

Human.—Dr. LeCron's clinical observations seem to indicate that similar changes may occur in man but probably with less constancy.

Temperature: The constant fall in temperature was the result of not attempting to supply heat superficially and therefore is insignificant.

Acetone: This was found in the urine quite commonly after chloroform; less frequently after ether; and not after gas. Clinically, it does not seem to follow gas-anesthesia even in diabetics.

General summary.—

Pathological: The drugs used in these experiments are capable of instituting degeneration-changes in the parenchyma of the heart, liver, and kidney, or of aggravating such changes when already established. These metamorphoses bear a serial relationship of increasing severity from which recovery is not always possible.

Anesthetics are to be regarded as toxic in their effects, and should be administered with due regard to their most dangerous action as affected by individual conditions.

Physiological: Ideal general anesthesia, pleasant and safe, seems to be impossible until a drug is found which will have a purely selective and benign action upon the sensorium. The nearest approach thereto may be the development of methods requiring the minimum of the least injurious drugs (probably the most transitory in action), which will least impair, or possibly enhance the efficiency of the cardiovascular, respiratory, or defensive mechanisms.

Clinical: Discouragingly discordant opinions, based upon personal experience and clinical observations, and therefore frequently biased, justify the statement that there is no method of anesthesia, single, combined, or sequential, which is so safe as to warrant its invariable application; on the other hand, chloroform may be said to possess no redeeming feature.

Experimental: The observations made in this series of experiments upon unfavorable animals under untoward conditions are in such accord with clinical evidence as to give hope that the experiments now under way, designed to determine the degree of persistence of the lesion caused by drugs and their effects upon resistance to infection, may permit of valuable deductions.

DISCUSSION

Dr. Amos W. Abbott (Minneapolis): I shall discuss only two features of Dr. Collin's paper, namely, vomiting and the condition of the urine. The statistics of my observations were taken in this way. The anesthetist kept tab of what occurred in the operating-room; the laboratory man took care of the urine, while the nurse reported with regard to vomiting, and I made up the statistics on these three findings. In the first place, in regard to the comparative amount of vomiting under ether and gas anesthesia. These were the only anesthetics used, and they were employed separately. All cases were excluded which had had a combination of anesthetics. Chloroform was not used in any of the cases. In the cases that vomited we excluded all stomach cases and all cases in which there had been any previous vomiting from any cause, and all cases which would be likely to have vomiting induced by sepsis, kidney conditions, etc. In fact, we excluded everything, as far as possible, to make it fair for the anesthetic. Under such conditions we had 110 cases since the first of January, 1911, and of this number there were sixty-seven which received ether, and forty-three which received gas. Of the sixty-seven which received ether, thirty vomited, or forty-five per cent, and thirty-seven did not vomit, or fifty-five per cent. In the gas cases thirteen vomited, or thirty per cent, and thirty did not vomit, or seventy per cent. This was manifestly unfair because we had not considered the length of time the anesthetic had been given; consequently we averaged the time of the anesthetics and we found that all those who had taken ether had taken it for sixty-eight minutes on an average. These were mostly difficult and prolonged cases. It took only twenty-six minutes on an average for the gas cases, so that there we must consider the fact that the ether given had been for much longer periods than the gas. The average duration in the ether cases, *that vomited,*

averaged seventy-two minutes. In those that did not vomit the average was sixty-nine minutes. In the gas cases the duration in minutes was forty-three for those who vomited, and twenty-six for those who did not vomit. The longer the time the gas was used the greater the tendency was to vomit.

I must differ with Dr. Collins that gas cases do not vomit. We find they do, and the longer the anesthetic is given the more likely they are to vomit. However, the period of vomiting is much shorter with gas than with ether.

One word in reference to the kidney examinations. These cases were all put under a rigorous examination before the anesthetic was used, and every case excluded that did not have normal urine before the examination. We found there were eighty-five of these cases which we considered fair, fifty-one of ether and thirty-four of gas. Of the ether cases which showed abnormal urine twenty-four hours afterward (especially albumin and casts), there were forty-three, and eight were normal. There is one curious thing to be noted here: In the eight cases in which the urine was normal after the anesthetic, *the patients had been unusually long under the anesthetic,* the average was seventy-three minutes. With the gas cases there were thirty-four; ten were abnormal afterwards, or twenty-nine per cent, and twenty-four were normal, making seventy per cent in favor of the gas, but here we must again take into consideration the length of the anesthesia, and we found that the ether administrations averaged seventy minutes, while the gas administrations averaged thirty minutes. The longest ether anesthesia was 120 minues, and the longest gas anesthesia was 90 minutes. We have tried a number of agents preliminary to the anesthetic. We used scopolamin-morphin, one-hundredth of a grain of atropin, one-half grain of codein, morphin alone, and morphin and atropin together, and so on, but finally settled down on codein, one-half grain before the administration of the anesthetic, and that is what we are using now.

DR. PEARSE: How much codein?

DR. ABBOTT: One-half grain hypodermically.

DR. PEARSE: How long before?

DR. ABBOTT: Fifteen minutes only.

DR. DANIEL N. EISENDRATH (Chicago): I rise simply to give the benefit of the experience we have had at the Michael Reese Hospital for the past five years in nitrous oxid anesthesia. I cannot give you any statistics, only general impres-

sions which I think may be of value, and there is one thing that stands out, and that is, one must look out for danger in using gas in cases of myocarditis. We have had several deaths from the use of nitrous oxid gas. We thought at first patients were immune to this anesthetic, and that gas was the safest anesthetic agent we could use. Nobody thought of danger in connection with nitrous oxid. We take it for granted that when nitrous oxid and oxygen are administered by experts the danger is comparatively slight. We have three of these expert anesthetists on our staff who do this sort of work, and we have had in the past three years three or four very unpleasant experiences of death, either at the beginning of the anesthesia or during the course of it, that we could not ascribe to anything else except to myocarditis. These unpleasant experiences may occur in young persons or older persons, but they are especially apt to occur in cases that have had a preceding sepsis. I recall one patient who had had a preceding general sepsis from a gangrenous leg; another, from a septic jaw; another young man died at the beginning of the anesthesia. I would sound a note of warning to the effect that we should be very careful under these circumstances and always select our cases if it is possible to do so. Gas, we have found, is the ideal anesthetic for cases in which there is bronchitis or nephritis present, and especially in kidney operations is it the ideal anesthetic to give. We have had a number of cases where ether has caused considerable irritation of the kidneys, such as Dr. Abbott has referred to, but in the majority of cases—and Dr. Abbott will find that is true—this irritation of the kidneys will disappear in three or four days.

SURGERY OF THE THYMUS GLAND, DUCTUS THORACICUS AND VAGI

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Physiology.—Physiologically, the thymus gland, like the tail of the tadpole, is of most importance to the fetus and infant, less so to children, and not at all to adults. Its function is not known.

Energetic experimental work has not added much to the physiology of this gland. Possibly it is only useful during the nursing period, or of greater importance *in utero.*

We find the following analysis of M. Friedlebin's work on this gland in the *Medical Times and Gazette* of July 23, 1809.

Anatomy.—1. The thymus is a gland without any external duct; it is composed of an infinite number of lobules, each one consisting of closed follicles, united together by a very fine cellular tissue.

2. Its nerves are the avenues of its vessels, and proceed from the ganglion of the sympathetic nerve.

3. The thymus has no free cavities; what have been taken for cavities are interlobular intersections.

4. It contains a secretion composed of a clear transparent fluid, holding innumerable round nucleoli in suspension, mixed with some cells.

5. The nucleoli pass directly into the veins of the thymus.

6. The follicles of the thymus continually perish and are renewed; the bodies which have been called concentric are only follicles during their metamorphosis.

7. The thymus increases continually from its embryonic origin up to the age of puberty, but its increase is relatively less than that of the body. Between the ages of fifteen and twenty-five it remains stationary. It begins to diminish in volume at the end of this period, rapidly decreasing in adult life. After this period the thymus is rarely met with; and in the form of fatty tissue.

Experimental.—Experimentally the thymus gland has been frequently considered anatomically, physiologically and surgically, but aside from its anatomical and surgical aspects, little is known, nothing definite having been discovered physiologically.

The glands of various forms of animal and insect life have been extensively considered. Their influence upon the sexual organs, the blood, the brain, and the nervous and digestive systems have all been subjects well calculated to occupy the minds of scientists.

PERSONAL OBSERVATIONS

Fish	*Reptiles*	*Birds*	*Mammals*
	Snakes	Eng. Sparrow	Rats
	Tortoise	Chickens	Mice
	Turtles	Robins	Cats
		Pigeons	Dogs
		Larks	Rabbits
		Catbirds	Squirrels
		Owl	Calf
		Hawk	Sheep
		Crow	Pig

MEDICAL TREATMENT

1. *X*-ray.
2. Radium.
3. Serum.

Radium, having been known to have a specific therapeutic effect upon neoplasms, has been suggested in

the various pathologic conditions of the thymus. It should be applied directly to the gland at intervals varying in time and duration of frequency by means of thoracotomy or thorectomy by flap or trephine.

Serum in the treatment of thymus hypertrophy has not been carried beyond experimentation, but as it has been beneficial in the treatment of other glandular affections it is reasonable to suppose that it will be found to be beneficial if not curative in this class of disease.

SURGERY

1. Intubation.
2. Tracheotomy.
3. Thymotomy.
4. Thymopexy.
5. Thymectomy.
6. Thymorrhaphy.
7. Status Lymphaticus.

Surgical aspects.—The supposed disappearance of this gland before the age of fifteen years has been confounding in having it to reckon with surgically in adult life, because of belation and its remnants undergoing changes of a more or less serious nature.

It is therefore a gland of great surgical importance in infants and adults, but more especially in the first fifteen years of life.

It may be necessary to attack it because of injury or disease. The effects of a large thymus, due to any cause, are almost purely mechanical. The sternum may be pushed perceptibly forward, or the neck upward, or both may exist at the same time. It may be pushed backward and downward or laterally, depending upon its size and the resistance of the sternum and soft structures of the neck. Its density may influence the direction of pressure, which is in the di-

rection of least resistance. Pressure may be directed upon the blood-vessels, trachea, or pneumogastric nerve, single or combined. The gland is surrounded by a loose capsule easily distended.

Intubation is resorted to as the simplest palliative measure, one that any novice may do with a rubber catheter, if other means are not at hand. Intratracheal rubber tubes are also effectual, but any tube should be open at the end and not laterally. They may be introduced without local anesthesia; seldom, if ever, pulmonary anesthesia.

Tracheotomy is second in choice to intubation as a palliative measure, many times necessitating the continuance of a tube varying in length within the trachea, sometimes extending to within one inch of the bifurcation of the bronchial tree.

This operation should be done with local anesthesia, but if necessary may be done without anesthesia of any form, local or general.

Thymotomy is done for cysts containing blood, pus, or serum, and the removal of foreign bodies.

Technic.—Make a median incision extending from the sternal notch, divide the soft parts by blunt dissection, down upon the gland. The tumor will then present itself. Open the capsule and withdraw the gland. If no lesion is found, without evidence of further direct surgical procedure, the gland may be returned, and the opening in the chest closed with or without drainage, usually with drainage.

Thymopexy.—With the presence of a cyst of any character the lips of the incision in the gland may be fixed in the thoracic opening by suturing the gland, and its immediate tissues, to the edges of the soft structures of the wound that drainage may be continued indefinitely. This procedure will often relieve all symptoms.

Thymorrhaphy.—Suturing of the thymus is done for incisions, lacerations, ruptures, and punctures. Small, heavy, sharp, curved needles carrying fine silk or linen or long-lifed catgut, as small as can be conveniently supplied, should incorporate as much tissue as possible and sutures should be uninterrupted.

Thymectomy.—If extirpation is necessary the gland may be readily delivered, and the blood-vessels ligated before they enter the upper pole, and the glands removed with but little difficulty. Since Rehr (1896), who was the first to remove the thymus gland, several operators have removed a score or more of such glands, improvement being the rule. The mortality has been but slight.

Ranschoff states that he saw a patient from whom Durante (1906) had successfully removed a sarcoma of the thymus including a portion of the innominate artery one inch in length.

Status lymphaticus does not always necessarily mean that the gland is enlarged,—it may or may not be so,—nor does enlarged gland necessarily indicate status lymphaticus.

Lang says: "Drawing my conclusions from cases recorded in the literature, thymus deaths may be grouped under three headings. The first group includes those cases in which there are actual pressure-symptoms appearing sometime before death and the post-mortem reveals evidence of pressure upon the mediastinal contents. In the second group, the thymus, while enlarged, does not produce any prodromal pressure-symptoms during life, and the post-mortem shows enlargement, but no actual signs of pressure. The fatal issue in these cases is explained by a sudden swelling of the thymus, due to some exertion, as in crying, or due to some interference with the circulation, as no doubt many of the cases of mediastinal

pathology or undetermined origin should be ascribed to the thymus gland or its rudimentary structures. Anatomical relations are changed so materially when large neoplasms are present that it is absolutely impossible to assign their origin, especially after the glandular structures have become absorbed as the result of age or disease. Spontaneous cure having not been infrequent, anti- and post-mortem appearances are so greatly at variance that much time and observation will be necessary to determine certain facts. Color, consistency, size, area involved, and bloodless conditions are markedly different in death and in life.

Pathology.—The thymus is as versatile as any other tissue of the body except the cutaneous structure. This is evidenced by the presence of congenital hypertrophy, abscess, cysts, tuberculosis, syphilis, angioma, nevus, hemorrhage, and hemophilia (direct or indirect), epithelioma, myxema, lipoma, fibroma, lymphoadenoma, and various types of sarcoma.

Any of these conditions may be found in infant or adult life, when in the adult a belated gland has been the cause.

THORACIC LYMPHATIC DUCTS AND GLANDS

Experimental.—Experimentally the lymphatic system of the thorax, like that of other regions, has been extensive and satisfactory. However, that pertaining to progressive glandular infection remains quite undeveloped. This is found to be so with malignant growths, their extension into certain groups of glands not always obtaining, causing wonderment. If the accepted rule of extension predominated, all malignant growths upon or within the thorax would become general, so that there would be no necessity for resorting to surgical measures of any kind or degree.

History.—Bartiolinus (1653) was one of the earliest to experiment upon the thoracic duct, while Cooper (1798) mentions three instances of obstructions to the thoracic duct with experiments, showing the effects of tying that vessel; and Amussat (1840) mentions an extraordinary development of the thoracic duct. Uspensky (1888) records most interesting experiments by ligating the thoracic duct to determine the effect on chemical and morphological substances of the blood. Sryeff (1889) ligated the duct of a dog to determine the effect upon nitrogenous metamorphosis, and Toushinnikeff (1891) ligated the duct to determine its effect on exchange of gases in animals.

Surgery.—Not only glands, but terminals, must be considered in the surgery of the lymphatics because infection of the glands and channels occurs alike.

History.—History of surgery of thoracic lymphatic system is of recent origin. One of the earliest reports is that of Keen (1894), who gives a résumé of four cases of wounds of the thoracic duct in the neck, all having been operated upon. Jesus (1895) records a case of ligation of the thoracic canal. Schminn (1896) mentions an injury to the thoracic duct at the root of the neck during a surgical operation.

Nattan-Larrier (1897) describes the technic for ablating this canal, while Cushing (1898) reports a case of operative wound of the duct which he repaired by suture, and Dianesly (1903) one in which he implanted the divided thoracic duct into the internal jugular vein with recovery. Thus there are in evidence sufficient data to warrant the assertion that the thoracic ducts are subject to the same surgical principles that govern veins and arteries, and that it will not be long until the number of operations for their repair will be legion.

Suturing incisions, lacerations, punctures by foreign bodies, and end-to-end and lateral anastomosis will obtain to the same degree.

The thoracic ducts may be exposed for surgical repair, but it is necessary to approach them through the neck or by means of a trans-thorocoplasty. (See thorocoplasty.)

Technic.—The rules for suturing blood-vessels obtain in surgery of the thoracic duct. (See arteriorrhaphy.)

Hypertrophy.—The ducts and glands frequently undergo hypertrophic and degenerative changes aggravated by irritation and infection, especially those of tubercular origin. All diseases of the respiratory system are more or less the exciting cause.

Symmers says (*New York Medical Journal,* May 20, 1911) in lymphatic leucemia enlargement of the cervical nodes commonly occurs, in which event the blood examination usually suffices to establish the nature of the enlargement. But in pseudoleucemia there are no characteristic alterations in the blood, and microscopical examinations of the affected nodes reveals no criterion by which the changes may be distinguished from lymphatic leucemia or from those instances of diffuse hyperplasia of lymphoid cells in which tuberculosis as the etiological factor is presumptive.

Cysts and ascites.—Cysts of the thoracic duct may originate within the wall, or the wall may become dilated to form a sac with a small opening connecting it with the main duct. They may be anomalous or congenital, or they may be due to injury or disease, involve any portion of the duct, and vary in size from a small pea to several inches in diameter.

They may rupture for the contents to escape into any portion of the mediastinal, pleural, or pericardial

cavity, one or all combined, or may rupture through the diaphragm from the pleura to occupy the abdominal cavity, such a case having come under my observation.

Glands may also become cystic and remain so, or may rupture for their contents to enter any of these cavities. Such cysts also vary in size, and their contents remain serous or become infected.

Ascites.—Chyle has been found occasionally within the mediastinal space associated with injury, disease, or anomalous conditions of the lymph-channels, and when present it may become absorbed if undisturbed and the opening in the duct closed, or it may be removed by artificial means, such as aspiration by trephine of the sternum or through the intercostal space, or by open drainage through an incision in the intercostal space, trephine, or a cartilaginous flap. If by the open method, the opened smaller lymph-channels may be ligated. When the ductus thoracicus is open it may be repaired by suture or closed by ligature. In either case the thoracic wall should be closed and drainage maintained indefinitely. Tape or rubber tubing is probably the most appropriate method.

Cancer.—The importance of the lymphatics, especially in malignant growths of the thorax and its viscera, requires them to be considered surgically, because without the removal of glands associated with cancerous growths a cure is supposed to be an impossibility. Is it possible for a malignant growth to exist without lymphatic involvement? If not, what proportion of glands and lymph-channels is involved? Are they involved as groups? Can one gland in a group be involved without all of that group being involved? Can one group be affected without all groups being affected?

Carcinoma and lymphosarcoma are two of the most common forms of cancer found in the thoracic duct and lymph-nodes. They occur both primarily and secondarily, more frequently, however, secondarily. The frequency of primary involvement being difficult to determine prompts this statement.

SURGERY OF THE VAGI

History.—Though the vagi have been described for several centuries, their function remained undetermined until comparatively recent date.

Loget (1849) mentioned the nature and veritable usages of the various anastomoses of the vagi, while Jacquart (1864) described pulmonary distribution in ophidilus. Langenbaker (1877) described that of the vagi in domesticated animals, and Stowell (1881) that of the domesticated cat.

Symptoms, diagnosis, and pathology.—Symptoms coincident with disease and injury of the vagi are not altogether defined. Many, no doubt, have been improperly ascribed, especially by the earlier investigators whose opportunities were limited. Compression, paralysis, neuralgia, neuritis, hypertrophy, atrophy, trauma, and neurosis, together with the various methods of producing them experimentally, have been the means of forming reasonable symptomatic conclusions.

Schwarzenberg (1768) mentioned a rare form of spasmodic convulsions due to certain conditions of the vagi.

Symptoms of pressure of aneurismal or other tumors upon the vagus and recurrent nerves are manifested by laryngeal disturbances, as suggested by Johnson (1875).

Helm (1882) reported on anatomy and pathology of the nucleus of the vagi with reference to the theory

of respiratory and cough reflexes of development and regeneration, and Habershore (1885) reported on the influence of cold shock upon the vagi.

Neuralgia.—Neuralgia of the vagi was described as early as 1828 by Pinel, since which time but little has been said in favor of its existence, because of the uncertainty of ways and means for its determination. The sensory fibers that enter into its construction, are no doubt responsible for more or less undetermined pain, so often manifested within the thorax.

Pinel (1828) reported a case of neuralgia of the pneumogastric nerve, and Prus (1829) one in which he observed symptoms simulating hysteria.

Schupmann (1840) reported a case of neuralgia of the vagus, while Lederer (1860) reported one similar in character.

Pressure.—Pressure of neoplasms and anatomical irregularities, both congenital and acquired, upon the vagi, has been known to produce physiological disturbances of the organs which they control.

In the *North American Archives of Medical and Surgical Sc.* Balt. 11, 172, 175, 1835, is mentioned a case of asthma; aneurism of the arch of the aorta, disease of the vagi and phrenic nerves, large glandular tumors compressing them, with hepatization of the lower part of both lungs and death from smallpox.

Herard (1846) reported a case of perforation of the bronchus and compression of the vagi due to tumor. Worthington (1855) records a death due to pressure of a tumor upon the vagus nerves, and Schwing (1857) one due to pressure from a stenosed foramen.

Sir Wm. Gull (1859) reported a case of death due to destructive changes of the lung from diseases in the mediastinum invading or compressing the pneumogastric nerves and pulmonary plexus.

Potain (1861) considered at length hypertrophy of the bronchial ganglion and its influence upon the vagi, and Hittner (1865) stated that a tumor involving the vagus caused peripheral and reflex pain.

Stackler (1882) contributed an essay in which he claimed that epileptic convulsions were due to compression of the vagi, while Chapin (1884) reported a case of death from pressure on a pneumogastric nerve.

Grande (1907) reported a case of compression of the vagi, and Oppert (1907) one of death due to pressure of a tubercular cyst.

Neuritis.—Neuritis of the vagi is probably of frequent occurrence. It may be primary or secondary; acute or subacute or chronic; localized or general; and due to disease and injury.

Rosch (1857) and Weiss (1842) each wrote upon the subject of inflammation of the vagi. Browne (1896) and Madir (1898) each reported cases which they believed to be of this character. Perna (1904) refers to inflammation of the inferior laryngeal nerve. Neuritis affecting the perineurium or sheath, results more frequently with an infected wound than without it, but the nerve-fibers may even then escape serious damage. If the infection extends to the endoneurium, the nerve-fibers will become more or less affected. Pathological exudate is always to be considered more or less seriously, especially in the parenchymatous form, for the disease originates in the nerve-fibers.

Hypertrophy.—Cook (1857) reported his observations on the ganglionic enlargement of the vagus; the probable function of the ganglion; and the position it occupies in the human subject and in several of the lower animals.

Hypertrophy of the vagi or bronchial ganglia has been observed in both animals and man, and is prob-

ably due to injury and disease. It may be localized or general.

Neurosis.—Neurosis of the vagi was considered an independent disease by Blufus (1842), Sherman (1856) and Lederer (1866)

Rupier ascribed its origin to the brain, and Forres (1877) wrote on functional disturbances due to neurosis of the vagi. Such conditions have been verified by more recent observers.

Traumatic pressure.—Pressure from depressed fracture of ribs or cartilages and vertebræ has been proven to be effectual in causing functional disturbances of the vagi, as have also foreign bodies entering from within and without.

Herard (1851) reports a remarkable case of asphyxia produced by a traumatic compression upon the vagi and sympatheticus.

Pain.—Pain in the vagi is reported by Anderson (1874), who states that it was of a burning character in the fauces, that it was attributed to the vagus, and that it was relieved by atropia.

Cancer.—Secondary cancer of the vagus due to infiltration of the neck is reported by McCollum (1869), Primary neoplasms of any character are indeed rarely if ever found in the vagi. If so, they have not reached the ordinary literary channels, though Taylor (1885) reported having observed a calcareous deposit in the vagus.

Paralysis.—Paralysis does not always result from severing or even excising portions of one or both vagi, though it quite commonly occurs, probably depending upon the point of severance. The sympathetic dominates after severance.

Paralysis of the vagi was reported by Coffier (1882) and by Holzknecht and Hoffbraur (1907), and also by Stenhaur (1908).

Repair.—Moreau (1877), by experiments upon albino rats, found that regeneration with complete restoration of function could be obtained after the vagi had been divided. His experiments were confirmed by Philapeaux during the same year.

New nerve elements form centripetally from the proximal end thus indicating that the ends of nerves must be united when completely severed. When not completely severed, the time required for regeneration is six to eighteen months, each depending upon the distance of the injury from the peripheral endings of the nerve.

Protopathic returns earlier than epicritic sensibility, the latter requiring two years. The area of the last sensibilities is greater in the protopathic form. Divided nerves do not lose their function to conduct impulses, and therefore do not undergo complete degeneration.

Surgery (experimental and applied).—The pneumogastric nerves may be lacerated or severed by injury or surgical operation, and thus require anastomosis by suture. The severance of one by external violence need not require immediate anastomosis, while the severance of both by external violence would probably result in too rapid death to permit of successful anastomosis. If one is divided by external violence, there is ample time for anastomosis. If one or both are divided by surgical operation while the chest is open, they may be immediately united, and perhaps the life of the patient saved. Double vagotomy has been done in dogs without causing death.

Experiments upon the vagi are of ancient origin. They have been made principally to determine their physiological effects upon the organs which they supply, but those to determine their surgical possibilities are of more recent origin.

Injections of various medicaments.—Stretching and the application, together with internal administration, of various drugs have been selected methods to determine certain functional results.

Experimental and applied surgery takes the following forms:

1. Compression.
2. Vagotomy.
3. Vagectomy.
4. Stretching.
5. Vagorrhaphy.
6. Electricity.
7. Miscellaneous.

Compression.—Compression is applied in various ways, by gauze, ligature, fingers, instruments. Persistent pressure will partially or completely destroy nerve-function. Compression of the vagi may be done artificially with gauze, ligature, instruments, or foreign bodies, or by neoplasis, fractured vertebra, ribs, or cartilages.

History.—Compression of the vagus nerves to determine its effect upon the respiratory and digestive tract, was done by Dupuy (1816 and 1821), and by Mayer (1827); while Habershon (1864) illustrated the effects upon aneurismal tumors after implication of the bronchus and the vagus nerves.

Navroski (1870) studied the effects of blood-pressure on the vagus nerves, and Waller (1870) compressed the vagus nerves to produce asthenia or anesthesia in surgical operations. He also compressed the vagus nerve in the cure or relief of various nervous affections.

P. Din (1872), after removing a tumor from the inferior carotid triangle, noticed considerable functional disturbance of the vagi, and Johnson (1875) recognized laryngeal symptoms resulting from the

pressure of a tumor upon the vagus and recurrent nerves. Salamon (1880) reported suppurating bronchial pneumonia, resulting from pressure of the vagus due to aneurism of the brachiocephalic.

Francois Franck (1886) discussed at length the communication of Lafont upon the various effects of compressing the vagus.

Boix (1893) produced tachycardia by compressing the vagus. Dubois demonstrated the therapeutic effects of compression of the vagus nerve, and Marklin (1893) compressed the vagus to produce systolic changes of the heart.

Walraveus (1896) compressed the vagus nerves to determine its effects upon urinary secretions.

Vagotomy.—Vagotomy may be done by incision, ligature, cautery, or laceration, such methods having been employed in both animal and man at every point throughout its course.

History.—Ware (1828) performed vagotomy to determine its effects upon the heart and lungs.

Bonley (1852) made a section of the vagus to determine the effects upon absorption of the stomach, and Boddart (1862) to determine the effects upon the lungs after section of the vagus nerves.

Roddaert (1862) reported his experiments upon consecutive section of the vagi for pulmonary lesions.

Krishaber (1869) reported his observations on the phenomena provoked by chloroform after sections of the vagi, and Boddart (1877) made some remarkable observations upon the results of simultaneous section of the vagi in the cervical region.

Francois Franck (1879), after injuring a vagus nerve with a ligature and contusion, restored its function by electric nervotomy.

Vaulair (1893) made successful division of the vagus without causing death, but Pavloff (1894) pro-

duced death of animals by section of the vagi. Martini (1894) made vagotomy and then sutured the ends together. Pavloff (1895) severed both vagus nerves of dogs to determine the results other than death. Herzen (1897) caused double vagotomy without death. Cheskoff (1900) vagotomized dogs with respect to circulation, respiration, digestion, and heart-regulation; and Ribera (1901) sectioned the vagus for a similar purpose. Marcenghi (1901) reported his observations of the effects of bilateral vagotomy upon respiration.

Nikolaides (1901) demonstrated the general effects of vagotomy, while Crile (1902) studied the effects of severing and mechanically irritating the vagi.

Gomes (1903) made a double vagotomy, and Fronis and Paferski (1904) made an intrathoracic section of the vagus in the abdominal cavity. Martini (1904) performed vagotomy upon dogs; and Luszkai (1905) anastomosed both vagus nerves and sympatheticus after they had been severed for experimental purposes.

Starch (1904) did an intrathoracic vagotomy, while Firori (1904) considered the surgical possibilities of the vagi.

Stewart (1905) made simultaneous sections of both vagi above the origin of the recurrent laryngeal nerves; and Cannon (1906) studied the motor activities of the alimentary canal after splanchnic and vagus section. Cannis (1909) observed the alterations of myocardia after vagotomy, and the same year reported a case of the survival and regeneration of the vagus nerves after double vagotomy; and Jacquet observed one of accidental section of the vagus.

Vagectomy.—Segments of the pneumogastric nerve were first removed for experimental purposes by Cruveilhier (1831) and Henkel (1833). Since then many

similar operations have been made upon both animals and man for various purposes.

Claude Bernard (1849) produced paralysis of the esophagus by resecting the vagus without producing death, as did also Bieroliet (1857); while Kappeler (1864) extirpated about one-half inch of the vagus for laryngospasm. Wood (1874) produced suspension of intestinal secretion and failure to produce purgation after section of the parvagum; and Vogel (1883) reported on the prognosis after vagus resection, while Arthud and Butte (1889) reported the results of their researches upon the effects produced upon the diaphragm by resection of the vagus.

Ramverida (1891) extirpated a vagus containing a sarcoma. Widner (1893) resected the vagus nerve; and Giordana (1893) considered the lesions of the vagi that might become surgical; and Park (1895) determined the results of resection of the vagus and phrenic nerves.

Preisz (1898) removed the vagus recurrens nerves in a case of chorea laryngis; and Marenghi (1898) recorded his observations on nervotomy of the vagi with reference to the problems of regeneration of their peripheral fibers.

Kachkavski (1899) excised simultaneously the vagus nerves in the necks of dogs without destroying their lives. Mollard and Regard (1899) reported on the lesions of the heart muscles; and Cervera (1901) resected the vagus to determine the results upon the function of the heart and trigeminal nerves, and the result of consecutive resection of the vagi. Ladouc (1900) communicated the phenomena of chromatolysis resulting from resection of the vagi.

Cheshkoff (1902) observed the lives of dogs for a year and seven months after simultaneous excision of both vagus nerves.

Ruddel (1902) resected the vagus nerve, while Veavt (1907) reported resection of the pneumogastric nerve for a primary sarcoma.

Tuffier (1907) considered the proposition of resecting the vagi, while Broechkaert (1907) wrote upon its technic, and Murcell (1908) resected the right vagus nerve containing a malignant neoplasm. Decknoff (1909) resected the vagus nerve in man; and Dechonoro (1909) also resected the vagus nerve.

Stretching.—Stretching the vagus nerve in animals has been done for many years for physiological purposes, but it was not done in man until 1898, when Jaboulay did it to relieve certain intrathoracic pains.

Vagorrhaphy.—Suturing may be necessary to unite the severed ends due to any cause. It can best be done with silk or catgut when the chest is opened by intratracheal insufflation of the vacuum-chamber. It may be immediately necessary when severed during a surgical operation of any character upon the thoracic viscera, or when severed by injury. The severed ends of these nerves have been successfully sutured in animal experimentation and in man.

Vagorrhaphy, primary or secondary, is employed for neurotomy or neurectomy due to accident or surgical trauma: primary when the suture is applied immediately or soon after partial or complete severance; and secondary when employed for anastomotic purposes after considerable time has lapsed.

Phillipaux and Vulpian (1863) were the first to demonstrate by animal experimentation that nerves can be united by suture without loss of function. This means of union is best accomplished with fine needle and silk suture, because of its superior strength and small size. One of the absorbable materials, such as catgut and kangaroo tendon, with the same strength and durability would be exceedingly objectionable, be-

cause of the necessarily increased size and the trauma resulting from it and the needle to carry it through the nerve. With normal nerve tissue a needle without cutting edges can be easily inserted, but with the presence of cicatricial nerve tissue, such a needle is necessary, especially with dense neuromata. With secondary suture, function is usually incomplete because of atrophy. The nerve may have become permanently shortened, thereby causing great permanent loss of function.

If electrical stimulus is effective by constant current, motive-power may be benefited. Sherren believes that the length of time of separation of the ends is of less importance than infection of the wound.

Wertheimer (1901) anastomosed a vagus nerve in the thorax of the human being.

Miscellaneous surgery.—In this class is found much interesting data pertaining to the general surgical possibilities of the vagi.

History.—Ware (1828) imposed trauma upon the vagus nerves to determine its effect upon the lungs and stomach, and Laffout (1836) injected hydrate of chloral and chloroform into dogs intravenously to determine the effects upon the heart and vagus nerves.

Fearn (1847) reported a case of gunshot wound of the internal carotid artery and division of the vagus. He ligated the artery, but did nothing to unite the ends of the nerve. Recovery.

Blake (1865) reported a wound of the neck, with apparent recovery and sudden death.

Boulland (1891) records a case of mortal injury to the vagus nerve. Djelicoff (1901) contributed to the study of the heart in accidents to the vagi.

Giordano (1893) reported on surgical lesions of the vagi, and Langley (1897) made a series of experiments about the function of the vagus nerve with the

cells of the superior cervical ganglion; and Cesipoff (1898) in the region of the central origin of the tenth pair of cranial nerves.

Powers (1903) removed a heavy silk ligature that had been applied to the right common carotid artery, which unfortunately had included its corresponding vagus nerve for more than one year. He also reported clinical symptoms before and after removal.

The after-care for sutured vagi should, as a rule, when through the neck, include drainage for twenty-four hours when not primarily infected, and continuously when infected primarily and secondarily.

Quietude, liquid diet, and recumbency should always be insisted upon.

Soiled dressings should be changed frequently, but irrigation seldom done.

SURGERY

1. Transcervical.
2. Transthoracic.
3. Trans-abdomino-diaphragmatico-thoracic.

(1) *Transcervical.*—Technic: Vagotomy, vagectomy, stretching, vagorrhaphy, and the direct application of the needle for electrolysis, or the injection of medicaments, are done in an incision through the skin and sternomastoid muscle at the level of the cricoid cartilage. The deep jugular is turned aside and the nerve separated from the common carotid artery and sheath. Great care should be exercised to prevent injury to the vein and artery.

(2) *Transthoracic.*—Technic: After severing the ribs at their sternal junction or removing the sternum, the vagi may be seen in the superior mediastinum behind the right innominate vein on the right side of the trachea.

(3) *Trans-abdomino-diaphragmatico-thoracic.*—Technic: The upper abdominal wall having been opened, the diaphragm may be incised one inch to the left of the gastro-esophageal junction, when the vagi may be observed with but little difficulty.

OBSERVATIONS ON THE PRESENT STATUS OF SURGERY FOR CANCER OF THE BREAST

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In classifying tumors of the breast it has been customary to divide them into two groups, benign and malignant. This division has, in a way, frequently prevented making a positive diagnosis in these cases, since it was inferred that it was not necessary to remove benign neoplasms, and that operations should be performed only in malignant cases. It is certainly most unreasonable to assume that fibroid and cystic tumors in other parts of the body should be removed, but that such growths in the breast should be allowed to remain. Obviously, it would be better to maintain, clinically, one class which would include all tumors of the breast without regard to their pathologic nature. From physical examination we can usually diagnose a cancer of the breast, but, on the other hand, we cannot say positively that a tumor is not a cancer. So far as we know at the present time, a differentiation other than microscopic cannot be made between a benign tumor and a very early malignant one.

Granting, then, a single classification for all tumors of the breast, they come under the same line of treatment, and malignant tumors may be treated by radical

excision at once, while supposedly benign and doubtful ones may be treated by removal of the tumor alone, followed immediately by radical excision if the growth prove to be malignant. Quite often a positive diagnosis of the nature of the tumor may be made from a gross section except in early malignancy, but in these cases we are never justified in disregarding the microscopic examination.

We are all familiar with the case of mammary tumor of many years standing which has recently increased in size or has become painful or developed attachments to the skin or underlying tissue. While this tumor is now undoubtedly malignant, in all probability it would have been found benign had it been removed early.

Halsted has demonstrated that, if we recognize a malignant cyst and perform the radical excision at once, the case is favorable. On the other hand, if we fail to discover the malignancy before the wound in the breast has healed, in all probability there will be recurrence, no matter how radical an extirpation is done secondarily.

Abnormal involution, which, from its frequent association, is sometimes termed *chronic cystic mastitis,* is a fibro-epithelial degeneration. This condition is seen in about 25 per cent of all benign cases of tumor of the breast and in at least 70 per cent of malignant ones, and it occurs more frequently than any other condition except carcinoma. Malignant degeneration takes place in from 15 to 26 per cent of this form of mastitis. (John Speese.) It is always advisable to consider any doubtful cases of this type as early malignancy, and to treat them as such.

We formerly believed that over 80 per cent of all tumors of the breast were malignant in the beginning, but recent reports have shown that 30 to 35 per

cent were initially benign. This does not indicate that earlier reports were incorrect, but it does indicate that this difference of 15 to 20 per cent is brought about by removing benign neoplasms while they are still benign, instead of waiting until they have become malignant.

Cancer of the breast occurs with greatest frequency in individuals between the ages of 45 and 55 years, although it occurs with greater frequency in earlier life than we formerly supposed; therefore, age can no longer be considered the important factor in determining whether or not a tumor is malignant. In Rodman's series of 5,000 cases, 9 per cent of the patients were between 20 and 30 years of age. In a series of 518 cases in the clinic at St. Mary's Hospital, 46 were between 20 and 35 years of age. Two of these were 21 years of age.

Methods of extension.—The attempt to solve the problem of the channels by which cancer is disseminated has shown us not only what tissues must be thoroughly removed, but also that patients with advanced mammary cancer will be more comfortable and live longer if they are left as they are than if they are incompletely operated upon. (Gibbon.)

Handley believes that cancer originating in the breast, disseminates always through the lymphatics in the fascia, and that the embolic theory has been accepted chiefly because there is no proof against it. Embolism is necessarily an impartial process to which all organs are liable and cancer is by no means impartial. The liver is much more frequently the seat of secondary carcinoma-nodules while the spleen and lung most often show emboli in pyemia. Handley also calls attention to the fact that each variety of primary growth has a special metastatic geography; for example, the breast and thyroid frequently show metastatic growths in bone, while in 903 reported cases of can-

cer of the stomach there were no metastatic lesions in bone.

The fact that the femur and humerus are frequently affected, and the tibia and radius almost never affected, would seem to argue against the embolic theory, as the terminal vessels which would be most susceptible to emboli are in these distal bones. It has been shown that thrombosis frequently destroys cancer-cells invading a blood-vessel, but this same destructive thrombus is not found when cancer-cells invade lymphatics.

There would seem to be no argument against the fact that the lymphatics are the chief distributors of cancer-cells from the breast, but it would also seem that the blood-stream does at times play a part in the dissemination. On several occasions we have seen cases in which there was no evident lymphatic involvement, and yet a well-advanced metastatic growth was present in one or more of the bones. Dissemination through the lymphatics means extension by way of the lymph-vessels and glands lying in the skin, subcutaneous fat, deep fascia, muscles, and bones.

The primary lesion is invariably a single focus. From this focus the cancer-cells are usually transmitted, first, through the lymph-spaces of the breast and then into the main lymphatic channels, and by these lymph-channels, which lie in the fascia, they are carried to the glands of the axilla. If the growth be superficial the cells may pass through the lymphatic vessels in the skin, and through these vessels come to the axillary glands. At least 90 per cent of the cases which have any other involvement than in the breast itself would show this extension into the glands of the axilla. Lymphatic vessels pass directly from the breast to the glands above the clavicle. We have never known these glands to become involved until after those of the axilla.

Cutaneous lymph-vessels and probably vessels in the deep fascia, as well, pass across the midline to the opposite breast and glands of the opposite axilla. The opposite breast is involved in from 10 to 12 per cent of the late cases. A set of vessels from the deep lymphatics that drain the inner half of the breast, perforate the second and fourth intercostal spaces and pass directly to the mediastinal glands. These deep vessels also communicate with the lymphatics of the liver, and invasion of this organ may be explained by reason of lymphatic dissemination. A number of these perforating vessels accompany the blood-vessels to the spine, and may invade the spinal column through these cancerous elements.

It was formerly supposed that muscles were not involved, except by extension in advanced cases. While it is true that they are seldom affected, as compared with fascia, at the same time we have had several cases recently in which the lymphatics, penetrating deep into the muscle, were extensively involved.

The frequency with which mammary carcinoma produces metastases in the bones is well known, and it is not my purpose in this discussion to endeavor to show whether this metastasis is brought about by extension through the fascia or by blood-embolism. The sternum and the ribs are the most frequently involved, and this involvement occurs by direct extension. The femur, bones of the spine, and the humerus come next in the order of frequency.

A cancerous bone may not produce any symptoms, either subjective or objective. In deciding whether a case of cancer of the breast is too far advanced for operation it is often advisable to have *x*-ray pictures made of the bones most frequently invaded, since it is obviously useless to remove the breast should one of the bones be involved. Sciatic pain may mean in-

volvement of the spine itself or of the bodies of some of the vertebræ; and we should observe such symptoms cautiously in patients presenting themselves for removal of cancerous breasts. On several occasions we have observed this involvement of the vertebræ demonstrated by the *x*-ray in cases in which we were unable to make out any extension through the local lymphatics. These cases, except for the distant metastases, would have been considered favorable for operation.

The abundance of the lymphatic drainage from the region of the breast renders it almost impossible to cure malignancy in young individuals, and especially if the breast be lactating. We have observed carcinoma in the lactating breast in many instances, in none of which did the individual live over two years.

Treatment.—In the past two years we have examined 264 cases of carcinoma of the breast. Of this number only 200 were considered operable, and 64 were passed as hopeless from the physical examination alone. In addition to these, of the 200 cases that were operated upon there were several cases that should have been refused had we known the extent of the invasion before starting the operation.

Of the 200 cases operated upon, 6 had lesions in both breasts. Of the 64 cases refused, 10 showed both breasts invaded. In other words, about 1 in 4 cases comes to the surgeon too late. The delay is usually the fault of the patient, though even now we too frequently have instances of "watching" supposedly benign tumors for signs of malignancy. Earlier diagnosis and better knowledge concerning the distribution of the lymphatics, have been most important factors in the advancement made in the treatment of these cases.

In order to make an early positive diagnosis it is necessary to remove, for macroscopic and microscopic

examination, all supposedly benign and doubtful neoplasms. It is also necessary to make an exploratory incision in cases of mastitis that have undergone recent change in size or character, especially if a nodule has developed or any one area of the mastitis has changed more than the whole breast-area. If such a case proves to be one of abnormal involvement, and the pathologist is in doubt as to whether or not it is malignant, it would seem advisable to remove the breast and fascia, including the axillary glands, but not to remove the muscles. This condition usually appears after the child-bearing period, and the conservative excision can be done with very little deformity and no interference with function.

The technic of radical amputation of the breast has changed but little in the past few years. A large amount of skin, equidistant in all directions, should be removed. It is very seldom necessary to remove enough skin to require skin-grafting to close the wound. Recurrences in the skin occur more frequently in cases in which a large amount of skin has been removed and the fascia saved than in cases where less skin was taken and a very free dissection of the superficial and deep fascias was made. This tends to show that the skin nodules are developed from extension along the lymphatics in the fascia and not from those in the cutaneous tissue itself. The most important part of the technic is the removal of a very extensive part of the superficial and deep fascias. This dissection must begin above the axillary structures, include the pectoral muscles and fascia of the axilla, and extend down over the rectus muscle, taking in a part of its fascia. In removing the pectoralis major the fascial excision is carried to the sternum and from there outward to the large muscles of the back. The muscles must be removed not only because it is necessary to do so to facilitate the axillary dissection, but

also because their lymphatics are, at times, involved.

The axillary dissection should be an attempt to remove all gland-bearing fascia and not the individual glands. In this way all the groups of glands lying in the axillary space will be removed in the one piece of fascia. If the supraclavicular glands are enlarged it is our custom to excise one under local anesthesia, and if it proves to be malignant no operation is advised, since it is probable that by this time other and inaccessible regions are involved. In cases with supraclavicular involvement in which we have operated, recurrence has occurred in a short time.

If there are many skin-nodules, or if the integument is brawny and edematous, though the local lesion can be entirely removed, in all probability there are internal metastases or bone-lesions, and the condition is hopeless.

The functional result after the removal of the muscles is better than might be expected. Many patients report that the arm and shoulder are nearly as useful as before. Not binding the arm in the dressing and starting passive and active motion a few hours after the operation, seems not only to make a better ultimate functional result, but also to be a large factor in eliminating the number of cases of swollen arm. Without removal of the muscles the arm and shoulder are as strong as ever. In about 10 per cent of our cases there has been, some time or other, swelling of the arm, due to a blocking of the lymph-vessels. This swelling may come after some years. In many instances it persists for years, and, except the inconvenience, gives no trouble. In some cases it passes off with returning use of the arm. In some cases, of course, it may be due to recurrence in the remaining lymphatics.

Though amputation of the breast is an operation of considerable magnitude, it is attended with practically

no mortality. Old age in itself is not a contra-indication to operation, as old people stand these operations very well. In 708 cases in which we have done the radical amputation from January 1, 1890 to November 1, 1911, there were but three deaths. One was from pulmonary embolism on the sixteenth day, and two were from late infections, one in the third and one in the fourth week.

The prognosis as to the probability of a cure in a case of carcinoma of the breast will depend (1) on the length of time the neoplasm has been developing, (2) on the degree of outlying involvement, (3) on the activity of the gland, which will be determined by the age of the patient and the relation to a period of lactation, and (4) on the thoroughness of the removal of the gland-bearing fascia.

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DATA COLLECTED ON 518 CASES OF CARCINOMA OF THE BREAST

From January, 1890, to January, 1910

Average age	55 yrs. 6 mo.	
Oldest*	75 yrs.	
Youngest**	21 yrs.	
No. of cases operated on over 10 years:		
Alive and well	21	(23.5%)
Dead	23	
Not heard from	45	
Total	89	
No. of cases operated over 5 years:		
Alive and well	74	(30%)
Dead	76	
Not heard from	89	
Total	239	
No. of cases operated over 2 years:		
Alive and well	233	(44%)
Dead	134	
Not heard from	151	
Total	518	

* Had history of 6 years tumor of breast; is alive and well nearly 3 years.

** Two cases. One of these had a history of 4 years tumor before operation, and is alive and with no recurrence 2 years after the operation.

FOR DISCUSSION SEE PAGE 324

SARCOMA OF THE TESTICLE, WITH REPORT OF A CASE

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Tumors of the testicle, ovary, adrenal, and kidney offer special characteristics, which is a chapter of its own. Much theorizing has been done regarding these peculiar tumors, and many notable papers have appeared in the last few years, attempting a classification of the same. Hypernephroma, nephroma, mesothelioma, sarcoma, sarcoma-carcinomatodes, teratoma, and mesoma chorio-epithelioma are some of the names which have been applied to these related growths. In this short paper we must confine ourselves to a description of the pathological condition of the tumor in our case, the operation done, and the results of the same. For more extended discussion of the pathology of these cases you are referred to the work of Grawitz, Zudeck, Storck, Wilson, Hertzler, Chavessu, Adami, and Ewing.

Dr. H. H. Waite, pathologist for the Medical School of the University of Nebraska, reports on our tumor as follows: Macroscopically, the testicle is found to be 7.5 cm. by 3.25 cm. On cutting into it, many fibrous areas were found. The cut surface presented a vascular appearance, hemorrhagic areas were found over the surface in large numbers. The picture was of areas bounded by connective tissue stroma, presenting an alveolar appearance, resembling a fibro-adenoma.

Microscopically, the specimen showed an atypical cellular infiltration. The mesoblastic areas of the rete testis showed alveolar arrangement in some parts, the alveoli being lined with columnar epithelium. Mallory's stain showed infiltrated connective-tissue areas, with spindle cells in small numbers, but large round cells predominating. The alveoli were very vascular, many of them surrounding arteries. The percentage of connective tissue seemed increased, and everywhere infiltrated with round cells. Adenomatous arrangements of the epithelium was present. The epithelium showed areas of infiltration also. The specimen presented the anomaly of epithelial and mesothelial cells infiltrating the same specimen. Some areas presented definite adenomata without infiltration. The infiltration does not extend into the epididymus, but the adenomata appear to begin at, or are very close to, the tubules or beginning of the tubules of the testes. The tumor is apparently of the embryonic type. The lymphatics seem to show no evidence of extension or metastasis. The tumor is, evidently, of the type of carcinoma-sarcomatodes of Adami. This tumor, to the writer, presented the following points of interest:

1. No tissue was discovered in the section that did not belong to the testicle.

2. Both mesoblastic and epiblastic tissue had begun a rapid wild growth with the mesoblast predominating.

3. It did not show any fat or areas of lipoid degeneration.

4. The origin of the tumor was either at the tubules or very close to the same.

5. There was no other tumor found at any distant point in the body.

HISTORY OF THE CASE

Patient, O. M., colored, aged 29; waiter by occupation; was seen early in 1911. He gave a negative

family history, especially in regard to new growths. His personal history was also practically negative. He had gonorrhea at 25 and 28; syphilis denied; and there was no evidence of infection present. As seems to be the usual thing in these cases, he gave a history of an injury to the testicle at the age of 12, but had no trouble to speak of until about ten months before we saw him. He did say that he had had dull pain in this testicle at times for ten years previously, and that the testicle seemed larger than the other. In the three months before coming to us, it became much larger and more painful.

From the history and the enlargement, eliminating tuberculosis testis and gumma, and because of the absence of glandular enlargement and the peculiar consistency and hard feeling of the testicle, a tentative diagnosis of malignant new growth, probably sarcoma, was made, and operation advised.

All forms of tissue known to the histologist have been found in tumors of the testicle. Verneuil found brain-tissue, nerves, and ganglion in his case. Chavessu found liver cells, muscle, and portions of a thyroid in some of his cases. Fetal skulls, cartilage, teeth, hair, and nails have been found in various other tumors by observers, and Ewing goes so far as to believe that all forms of embryonal tumors of the testicle are teratoma in origin, with some form of tissue predominating, according to the ordinary characteristics of the teratoma. Langhans first made a careful microscopic study of these tumors and believed that he could trace them to the tubules, and the tumors containing alveoli lined with epithelium were really of a carcinomatous type. According to Ewing this fact lacks confirmation. He further states, however, that in his laboratory, in several thousand sections, from the testes of 25 children he found stray groups

of epithelial cells in numerous cases about or within the tubules, but was not satisfied that these cells were the origin of all forms of these embryonal tumors of the testicle. Chavessu assumes an origin in the spermatoblast for all the large round-celled tumors, which he believes to be different from the ordinary teratoma. The small-celled tumors he regards as of teratomatous origin.

Much theorizing has been done regarding the origin of these tumors. Waldemyer, Riebert, and Ewing seem to believe that these growths, since they are particularly common in ovary and testicle, are in some way related to the sexual cell. Ewing farther states that the theory of Waldemyer and Riebert becomes more and more clear as investigation along this line proceeds. Ewing's conclusions are the following:

Chondroma, myxoma, lipoma, and carcinoma have not been shown to exist apart from a teratomatous origin. The alveolar large round-celled perivascular tumors, as in our case, are proven to be of teratomatous origin. Ewing farther states that the commonest tumor of the testicle is an embryonal carcinoma, alveolar in type. The tumors are one-sided developments of the teratoma.

Chavessu, in 128 cases, found 66 malignant, 1 case of pure sarcoma, and 15 cases of mixed tumor. Kober finds 45 tumors, which he classes as sarcomas of the testicle, but does not state how many of them are mixed tumors. Bland Sutton, in an article describing his operation, finds 12 cases of sarcomata of the testicle in the London Hospital for the year 1897. The sarcomas are not classified into their different types.

Hermaphrodites and cases with undescended testicle are particularly prone to this type of tumor, 20 per cent of cases occurring in these individuals.

Roger Williams reports 8 cases of bilateral new growths, 3 of them in early life, and 5 in adult life; he calls attention to the fact that these are found to be round-celled sarcomas more often than any other type.

Rogers reports a case of double undescended testicle with an abdominal tumor which proved to be sarcoma complicating delivery. Two cases are cited by Kronpecher of sarcoma of both testicles in double cryptorchids.

Age seems to have little bearing, as cases are reported at all ages, from infancy up. Silcock reports a case of congenital sarcoma, and Minot reports a case in a man of 60. Most cases, however, are found in the third decade. Two cases are reported with a syphilitic history, and one case of mumps with metastasis to an undescended testicle was sarcomatous. Chavessu reports the work of San Felice on the artificial production of tumors by the injection of saccharomyces neoformans into the testicle. We also have Bruandet's work, in which he obtained an epithelial infiltration by the injection of different substances, as macerated carcinoma of the stomach, gastric juice, and so on. He concludes that they do not throw much light on the subject, and are of little value.

Among the symptoms are enlargement of the gland, which is usually rapid, as in our case where the most of the growth occurred in three months. Pfaff reports a case in which an undescended testicle became as large as a fetal head in two months time, and mentions a case of Wyeth's similar to this. There is usually dull pain, although it is not always true, and the testicle is abnormally tender on palpation, and of a peculiar consistency.

The differential diagnosis is not a difficult matter, as the rapid growth, pain, and tenderness should lead

one to suspect malignancy. Gummata, tubercular testicle, and hydrocele are to be differentiated. The history of chancre and other evidences of syphilis, together with the slow growth and absence of pain, are characteristics of gumma. The tubercular testicle is of even slower growth. Hydrocele should offer no difficulties.

The prognosis is always bad in malignant new growths of the testicle, and especially is this true of sarcoma. There are cases of reported cure, but as to whether or not there was return, perhaps, we should say, the development of abdominal metastasis, there is a profound silence. In regard to abdominal metastasis, Osler, on malignant new growths, suggests that in cases of obscure abdominal new growths examination of the testicle may clear up the picture. Although Coley reports the cure of inoperable metastasis from sarcoma testis with his serum, the only hope for cure lies in the early diagnosis and radical operation.

J. B. Sutton describes the following operation done by him for the radical removal of all possibly involved tissue, which we performed in this case:

An incision was made into the scrotum and the testicle and vessels and cord freed to the internal ring; the testicle was then covered with gauze, and an abdominal incision made in the abdominal wall along the semilunaris line from the costal arch to the inguinal canal. This incision was made down to the peritoneum and the peritoneum pushed back, and traction on the testicle showed the position of the spermatic vessels in the loose areolar subperitoneal tissue. The vas and artery were ligated and divided at the brim of the pelvis. The retroperitoneal tissues of the right lumbar region were well exposed, and careful search was made for enlarged lymphatic glands, but none were found, in this case.

Jameson and Dobson (*Lancet,* Vol. 1, 1910, p. 493) urge the removal of the cellular fatty tissue surrounding the glands because of possible involvement. Howard, following their suggestion, did an operation even more radical than the one just described. In his operation the abdominal incision extends from the external ring in a curve external to the linea semilunaris to a point an inch and a half above the umbilicus; all layers of the abdomen are incised and the peritoneum exposed. This is then dragged away from the retroperitoneal tissue, and the aorta and common iliac vessels exposed from the renal vessels down. The tissues around the aorta, renal arteries, inferior mesenteric, common and internal iliacs, and the beginning of the internal iliacs were removed. The spermatic vessels were stripped away from the peritoneum as far as the renal vein, and ligated, and the whole growth,—artery, veins, and lymphatics,—was removed. After the removal of the testis the peritoneum was replaced, and the wound closed with drainage.

When we remember that the lymphatics of the testicles discharge high up into the aortic lumbar glands, on the left into three glands to the left of the aorta just below the renal artery, and on the right into 3-5 glands to the right of the vena cava between the vena cava and the aorta, we see the importance of getting them all out, in order to prevent all possible recurrence.

CONCLUSIONS

1. Typical sarcoma of the testicle occurs more rarely than atypical.

2. Tumors of the sarcoma type, but atypical, occur more frequently than those of the carcinoma type, Ewing to the contrary, notwithstanding.

3. Typical sarcoma of the testicle occurs occasionally, but always arises in the epididymis or tubules

and never in the rete testis. All tumors taking on a carcinomatous appearance are teratomatas in origin with the epiblast predominating.

4. The mixed tumors of the testicle originate in the rete testis in tissues which, according to Grawitz, have their beginnings in primative kidney embryonal tissue of mesoblastic origin carried down in the descent of the testicle. According to Waldemyer they originate in the sexual cell, which has been subjected to some form of irritation. This last theory agrees more clearly with the clinical picture than does the theory of Gramnitz.

5. The literature on prognosis is so fragmentary and imperfect that I have been unable to lay down any principles for operation from the accumulated literature, but I believe from the pathology of the tumor that by the time clinical diagnosis is possible an operation as radical as that of Bland Sutton's should be done, and that the removal of the testicle and cord only out of the abdominal cavity, begs the question and is never indicated.

FOR DISCUSSION SEE PAGE 324

THE RESULTS OF THE TREATMENT OF CANCER OF THE UTERUS BY THE ACTUAL CAUTERY, WITH A PRACTICAL METHOD FOR ITS APPLICATION

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Any treatment of cancer of the uterus, whether by the knife or the cautery, can awaken, of necessity, but little enthusiasm. Until the embryologist, the pathologist, and the bacteriologist widen our horizon as to the causes back of this condition, we can hope by an honest exchange of experiences, only to prolong life, and with this add comfort to the unknown number of days that a given case will live. No true idea of what any of our present-day methods will accomplish in the way of prolonged life in comfort, or of cure, can be known until each surgeon who treats them at all reports his experiences in each and every instance, and never, under any circumstances, omits his final results in any case. The average primary mortality after the use of the knife in cancer of the cervix and uterus is probably no less than it was when abdominal and vaginal hysterectomy were first attempted. This, as we all know, is so high that it robs the subject, I repeat, of the zeal that we might otherwise have for it.

But cancer of the uterus is a real fact in our daily work. The ordinary fellow of our number sees relatively as many as the master surgeon. The latter can do a Reis-Wertheim, the former cannot. I am sure that, so far as womankind in general is concerned, it is most unfortunate that there are not a few surgeons who do no other work than hysterectomies. Assuming that the Ries-Wertheim operation is the highest expression of skill and judgment for an abdominal hysterectomy in cancer, it is to be regretted that all the cases developing in this country could not be turned over to the surgeon who would attempt no other form of operative work. But we must all agree that this, desirable as it must be from the standpoint of the afflicted, is but a surgical dream. If the knife, after all, is to remain for years yet to come the important arbiter of the woman afflicted with this disease, then the public, I am sure, will at no distant day demand that only the man thus trained be given this work.

But, personally, I believe that the removal of the cancerous uterus by the knife is nothing less than legalized assassination. Say what we will, the primary operative mortality is absolutely unknown. It is unknown simply because it is so oppressively high; and when this is true in any operative condition, the rule is that only the exceptional recoveries and the apparent cures creep into the literature. In view therefore of the high primary mortality, as well as its moral and sociological aspects, I shall dismiss, for the purposes of this paper, the subject of hysterectomy from an operative standpoint, total, complete, or otherwise, as not worth the effort.

In its place, I want to offer a procedure which is based on the work of the experimental laboratory, and, in addition, an improved method of its applica-

tion. So far as I can learn, the basis of the procedure is new in the details of its use, and this is also true of the method by which I limit the destructive effects of the cautery outside of the pathological area. It is not necessary for me to take up time in declaiming the value of the actual cautery in cancerous growths, for this would be but a repetition of an important part of the medical history of the human race. Let me say here, for fear I may be misunderstood, that this method is advanced only as the best palliative treatment of cancer of the cervix and body of the uterus that is known today. That it may also, in certain early stages of cancer in this region, give a symptomatic cure for many years, I am convinced. Dr. Leo Loeb, in a personal communication, stated that mouse cancer could not be successfully transplanted if the temperature of the section was previously raised thirteen degrees, Fahrenheit, above the human normal; while a very low degree of cold, twenty-two degrees below zero, seems to exert little or no retarding effect in its power to grow when a control-section is transplanted into the same animal.

How much this has to do with the unquestioned benefit that the cautery exerts in some cases in retarding the growth of the ordinary forms of cancer is difficult to prove; but, personally, I believe that it is the real explanation of the benefits obtained in this class of cases by those who have made use of it. More than this, I have believed for a long time that, if some rational method could be devised, by which a high degree of heat from an actual cautery could be regulated while being applied to the cervix, or body of the uterus, without destroying or even injuring portions of the vagina, bladder, rectum, intestine, or ureters, the results from this method of treatment could be made to show better than any yet devised

from the standpoint of the scalpel, not excepting the method of Ries-Wertheim in the hands of the average operator.

Before describing the method that I believe will extend the benefits of the cautery operation in uterine and cervical cancer, permit me a word of historical reference, especially as it refers to one surgeon, the late Dr. John Byrne, of Brooklyn, N. Y. In 1892 Dr. Byrne, while serving as president of the American Gynecological Association, read an address which, in its essence, referred to the relative merits of total or partial hysterectomy for cancer of the cervix by the ordinary methods of his day, and supravaginal excision by the galvanocautery. Dr. Byrne's work has been referred to in a number of articles that have appeared this year,* and none has questioned the very favorable reports of results by this surgeon. The four articles that I have included in the foot-note herewith are valuable because they refer, not only to the abdominal and vaginal routes from the operative standpoint, but also to the use of the cautery, and, as well, the question of metastasis.

Dr. Byrne, in his address in 1892, concluded, in part, as follows: "As operative surgery [in cancer of the uterus] is in many respects more dangerous than the disease for which it is undertaken, and as the majority of all patients afflicted with uterine cancer would live longer without than with it, it is not a safe or a useful operation, and, as such, is unjustifiable." This author says further: "Amputation of a cancerous cervix by the cautery-knife is free from danger,

*"Treatment of Inoperable Cancer of the Cervix." Palmer Findley, M. D.: *Jour. of the A. M. A.*, April 22, 1911.
"Use of the Cautery in the Treatment of Carcinoma of the Cervix." Carlton C. Frederick, M. D., *Jour. of the A. M. A.*, January 14, 1911.
"The Results Obtained by the Radical Abdominal Operation for Carcinoma of the Uterus." J. H. Jacobson, M. D., *Jour. of the A. M. A.*, January 14, 1911.
"The Participation of the Tissues Adjacent to the Uterus and of the Pelvic Lymphatics in Uterine Cancer." John A. Sampson, M. D., *Jour. of the A. M. A.*, January 14, 1911.

a safeguard against all infection, traumatic or septic, and, what is of still greater importance, is destructive to latent cancer cell-proliferation in tissues far beyond the line of incision; hence, much more is comprised in the operation than the mere removal of a part, or parts, not more actively involved in the work of destruction." The address is concluded with the following piquant observation: "Any method of operating, for which advantages so vital and so far-reaching can be claimed and established, and which thus distinguish it from all others, renders its adoption on the part of those who undertake to operate for cancer of the uterus no less than a moral obligation."

Unfortunately, those who extol the advantages of the cautery in cancer of the cervix and body of the uterus say nothing about its disadvantages. These, in the far-advanced case, especially when the soldering-iron is used as the cautery, are both insistent and real. The difficulty is in optionally regulating the heat that is applied to the area to be treated. My experience has been that the case inefficiently treated by the cautery is in as great danger from a rapid recurrence as is the case treated in an unsurgical way by the knife. On the other hand, if the cancer is cauterized to the degree that is necessary in an advanced case, no method or instrument has been devised up to the present time, so far as I know, that will protect the vagina, even when not invaded by cancer, from ultimate advanced cicatricial contraction. Here, too, the possibility of a vesicovaginal or a rectovaginal fistula is not an unimportant danger. If the vagina is almost obliterated, or greatly contracted by cicatrix, because of the use of the cautery, a recauterization, which is sometimes necessary, may be out of the question. If a vesicovaginal or a rectovaginal fistula develops as a result following the use of the cautery, one cannot help but question what the patient has gained in the

comfortable prolongation of life aimed at; certainly not very much.

The object striven for by Dr. Byrne seems to have been a high amputation of the cervix with the electric cautery; in other words, a supravaginal amputation. In the *American Journal of Obstetrics,* Vol. 26, 1892, pp. 578-579, are four very beautiful illustrations which show Dr. Byrne's conception of the use of the cautery in this disease. According to these illustrations, Dr. Byrne was able to cone out a uterus and leave merely a shell, evidently by simply sensing by the hand holding the hot knife.

Personally, the greatest fear that I had in my early work was cauterizing the bladder, ureters, or rectum. The ureters are particularly in danger because cancer so frequently starts in the fornix of a lateral tear, and to attack and follow it up with an unregulated, or unknown, quantity of heat, is the real problem in the use of the cautery in this region. It was this fear, on the one hand, of too much heat, and, on the other, of not enough, that led to the development of the technic which I now use, which is as follows:

1. The abdomen is prepared as for any abdominal section.

2. The patient is put in the full Trendelenburg position.

3. An abdominal incision is made just sufficient to admit one or two fingers of an assistant into the pelvis; in the thin patient, one finger is enough.

4. A fever-thermometer, indexed to register at least 250° F., is introduced through the urethra into the bladder after the urine is removed by a catheter. A second similar thermometer should be in readiness for use in the rectum, if it is found necessary to cauterize deeply posteriorly. The fingers can be used here also.

5. The cautery is applied in the vagina through a Ferguson speculum, made on the plan of a vacuum bottle.

6. There is no use of attempting this work unless the cautery used is perfect in its action, i. e., has more heat under control at your command than you will ever require.

I believe that I have such an instrument, which was made for me by the Vulcan Electric Heating Company, of Buffalo, N. Y., which I show herewith. (Fig. 1.)

The combination of procedures that I have outlined above, viz., the Trendelenburg position, to empty the pelvis as far as possible; the button-hole incision, by which the assistant's finger can roughly, but for all practical purposes, determine not only the degree of heat coming into the pelvis, but the proximity of the cautery-head to important structures; the thermometer in the bladder, rectum or urethra, to determine accurately the amount of heat that is coming into these important structures; and, last, but by no means least, the use of the principle of the vacuum bottle in a speculum to preserve intact the vaginal walls, to say nothing of the vulva, removes the use of the cautery in cancer of the uterus and cervix from the uncertainty and inexactness which have previously been true of it. (Fig. 2.)

This speculum which is made for me by Mr. Francis Storm, 63 Fulton street, New York, promises to solve the important problem of protection of the vagina and vulva from the great heat. As a result, the after-condition of the patient is one of comfort, and necessitates spending but a day or two in bed.

The use of asbestos paper in protecting the vaginal or vulvar walls from the heat is decidedly of no value. The heating engineer puts around his steam-pipes

asbestos to a thickness of three-fourths of an inch to retain within the pipes heat of 250 degrees Fahrenheit. The heat developed from the cautery is in the neighborhood of 1,000 degrees Fahrenheit. How much actual protection the thin sheet of asbestos paper will give when used, can be understood from the above comparison. I have had no experience with the water-cooled specula, but I do not see how they can be made self-cooling without being cumbersome, expensive, and much less efficient than the one here offered.

If the observation of Loeb, that mouse cancer cannot be replanted successfully after raising its temperature to 113° F. plus, holds true in human cancer to the same extent, then, with the procedure outlined above, we have a more efficient method than the most refined operative measure so far devised.

The tragedy of the knife in hysterectomy for cancer of the uterus is the energy of growth in the autoplanted cells after an incomplete excision. The knife seems to mechanically stimulate the cells that it turns into a new environment, just as the thread drawn through the sluggish, although malignant, tumor of the mouse, will seemingly insult it into new potency.

The heat in the pelvis can be raised approximately to 120° F. This can be determined by the finger or the thermometer in the pelvis, as already outlined. The finger of the surgeon will rarely stand a continuous temperature over 120° F., but it takes a higher degree of heat than this to produce a burn of the first degree, so that the effect of this increased energy in the way of heat can be made to diffuse itself through the pelvis and lower abdomen far beyond the immediate contact of the cautery-point. We should not forget, also, that the tissues to which the

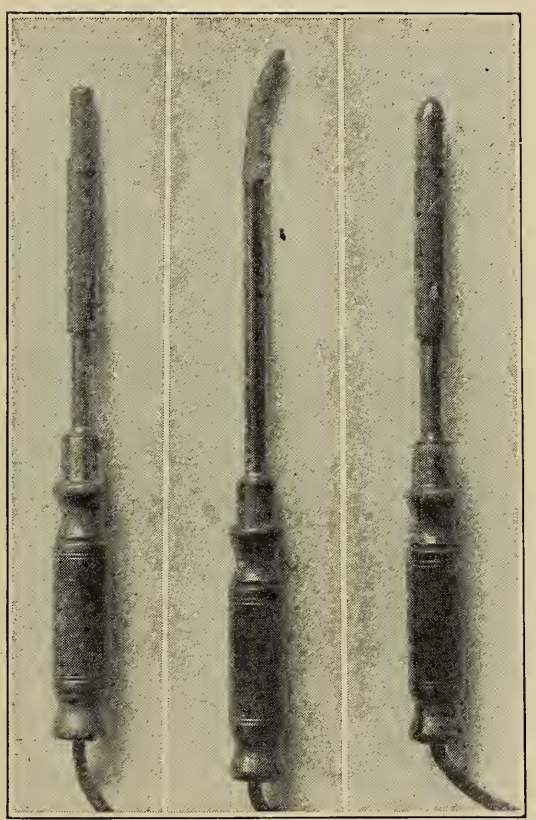

FIG. 1.

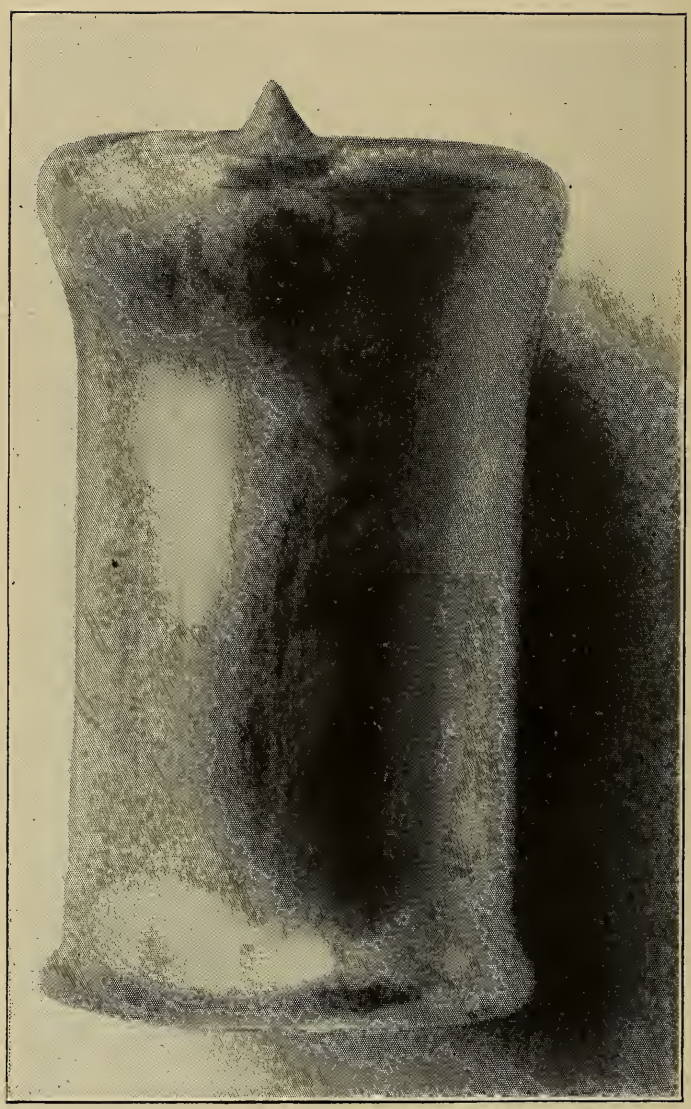

FIG. 2.

cautery heat is applied are wet, and that some of the diffusion of heat must be in the form of steam. Because of the wet tissues, the temperature rises slowly in the pelvis.

In closing, I want to strongly advise against the use of the curette as a preliminary to cauterizing or operating on the cervix or uterus when malignant. Those of us who have studied cancer in serial section have witnessed portions where eroded lymph- and blood-vessels were penetrated by the aberrant cells, to be carried by these currents to distant parts of the body. The sections that I obtain for microscopical study of cancer in the living subject are neither cut nor scraped: they are burned off with the cautery knife.

Heretofore I have not tried to do a supravaginal amputation with the cautery, as advised by Dr. Byrne, because under former methods it was impossible to tell how close the cautery-point was to the serous surface of the uterus. Under the technic above outlined, the Byrne operation is feasible. For the purpose of clinical work, I have divided this disease into two classes: the one involves the cervix and, with it, often the vaginal walls, including the urethra; the other recognizes the uterus as the principal factor, and, when present, the secondary involvement of the broad ligaments and adjacent pelvic tissues. The main object of the treatment is to raise the temperature in the outlying tissues to a point which will prove inimical to the further development of the cancer cells, while destroying the gross pathological condition with the fire at the cautery-point. It is for this reason that I have had these points made so heavy, in order to carry a maximum of heat. A small point will cut when hot, but it will not heat to the degree required. When the anterior wall of the vagina is involved, I put the

thermometer in the urethra, and make it register a temperature of 115°-120° F., by the smallest cautery-point in proximity to the anterior vaginal wall. It is quite surprising to note the amount of heat that the pelvic tissues will tolerate without giving way. The explanation must be that when the process of repair is inaugurated, the heat-destroyed tissues act as a scaffolding upon which the new normal repair cells bridge their way.

The method outlined above should precede all operations, even where the knife is chosen as the justifiable means to be used for the removal of the cancerous cervix or uterus. In the after-treatment, no packing is used in the vagina.

As to results: Unfortunately, all of my uterine cancer cases have not been treated by the methods here outlined. In common with others, I have used the knife more than the cautery, and, as a result, I have no advanced operative cases that lived long enough after operation to make statistics valuable enough to quote. With the cautery, thirteen cases have been treated, the first being done September 22, 1903. Of these, I have one living (Case 5) three years and three months after the use of the cautery. The base of the cervix in this case was over three inches in diameter, and the cauliflower-like growth filled the entire vaginal space, ballooning it to a considerable degree. In addition, the woman was almost exsanguinated, and with this a hemoglobin percentage of thirty. Another patient (Case 3 in the table) lived two years and two months after the use of the cautery, and died after a short but unknown illness. In this woman, only the cervix seemed to be involved. Case 1 lived one year and seven months, Case 6 lived one year and eight months, Case 7 lived eight months. It must be remembered that these cases were submitted to the cautery because, from a clinical standpoint,

TABLE OF RESULTS IN DR. PERCY'S CASES OF CANCER OF THE UTERUS TREATED WITH ACTUAL CAUTERY.

No.	Name	Age	Parts Involved	Character of Involvement.	Date of Use of Cautery.	Repeated.	Results.
1	Mrs. W.	53	Cervix & Uterus.	Infiltrating.	Sep. 22, 1903.		Lived 1 year and 7 months.
2	Mrs. W.	49	Cervix, Vagina, Uterus, Broad Ligaments.	Infiltrating.	Aug. 29, 1904.	Dec. 12, 1904.	Lived 7 months.
3	Mrs. A.	76	Cervix.	Infiltrating.	June 19, 1906.		Lived 2 years and 2 months. Died after short but unknown illness.
4	Mrs. D.	55	Cervix.	Vegetative.	Sep. 25, 1906.		
5	Mrs. F.	45	Cervix.	Enormous Vegetative.	Sep. 21, 1908.		Still living and well, 3 years and 3 months after single use of cautery.
6	Mrs. S.	49	Cervix, Vagina, Uterus, Broad Ligaments.	Infiltrating.	Nov. 7, 1908.	Dec. 18, 1908.	Lived 1 year and 8 months.
7	Mrs. C.	58	Cervix.	Infiltrating.	Dec. 18, 1908.	Mar. 22, 1909.	Extensive involvement of vagina and right broad ligament. Lived 8 months.
8	Mrs. H.	57	Cervix and Post Vaginal Wall.	Infiltrating.	Feb. 18, 1909.		Died uremic, 20 days after treatment.
9	Mrs. N.	57	Cervix, Vagina, Right Broad Ligament.	Infiltrating.	Nov. 4, 1908.	Mar. 2, 1909.	Vesicovaginal fistula. Lived 8 months after first cauterization. Vesicovaginal fistula followed second cauterization.
10	Mrs. C.	48	Cervix and Body of Uterus.	Infiltrating.	Mar. 10, 1910.		Lived 40 days.
11	Mrs. H.	46	Cervix, Vagina and Uterus.	Infiltrating.	Mar. 21, 1910.		Lived 3 months.
12	Mrs. S.	50	Vagina, Cervix, Uterus, Pelvis.	Infiltrating.	Apr. 3, 1911.	Apr. 22, 1911. June 19, 1911.	Lived in comparative comfort for 6 months. Practically no morphine until last few days, and offensive discharge greatly reduced.
13	Mrs. H.	42	Cervix.	Vegetative.	May 1, 1911.	Oct. 9, 1911. Vaginal Hysterectomy.	Hysterectomy was done because of signs of recurrence in posterior part of cervix. This case should have been amputated supravaginally, with cautery primarily.

they were considered otherwise inoperable. If all cases of cancer in the region of the body under consideration were submitted to the improved cautery operation here described, I am more than convinced that we would obtain, not only the advantage of no primary mortality, but, in addition, a largely increased percentage of lives greatly prolonged in comfort, with freedom from hemorrhage, exhausting and offensive discharges, and mental distress; and, more than this, an appreciable number of symptomatic cures extending over a period of years would result.

DISCUSSION OF THE THREE PRECEDING PAPERS

Dr. Jabez N. Jackson (Kansas City, Mo.): I have listened with great interest to the paper of Dr. Judd, and it is evident that we may premise our present position on cancer of the breast by saying that there are three factors which affect the future welfare of surgery in cancer of the breast. The first of these is early operative intervention; the second, avoidance of clearly inoperable cases; and the third, proper surgical technic.

The most striking improvement that can be made in the future in our work on cancer of the breast will come when we are able to secure for operation cases at an early period of involvement. It is practically universally accepted today that every cancer of the breast is a purely local disease at some time, and if operated at this time of definite localization practically all cases of cancer of the breast would be cured. The difficulty has been with the surgeon to get hold of the cases of cancer of the breast at a sufficiently early time. In my judgment the main cause of our failure to receive cases earlier is the unfortunate tendency to wait for diagnosis. The dictum should go forth from the surgical profession that *every tumor of the breast should be operated on immediately upon discovery, before a diagnosis as to its nature can be made.* If we are able to follow this out and instruct the general practitioners relative to breast tumors we will make an advance, along this line, of great possibilities. If we could convince the general practitioners and the people of the fact that eighty per cent of all tumors of the breast when seen are malignant, and that over half of the remaining twenty per cent which start out as benign tumors develop

malignancy, the surgeon would see many of these cases at a much earlier date for operation than he does at the present time. The individual who first observes a tumor in the breast of a woman must assume that it is cancer in nine cases out of ten, whether it presents symptoms or not. Further, *no* tumor of the breast can be cured except by extirpation. No argument against operation can therefore obtain, since the removal of the tumor is indicated whether malignant or not. In my judgment, therefore, the correct proposition is to insist that every breast tumor should be operated on as soon as it is discovered, before we can make a diagnosis clinically. After the tumor is out, the diagnosis can often be made by the naked-eye appearance of the gross tumor. If there still be the slightest doubt, this should be supplemented by an immediate examination of a frozen section by a competent pathologist. This report can be obtained with only a few moments' delay, after which we will feel sure that no error is made. If the tumor is simple, one has but to close the wound without further sacrifice of breast structure. If malignant, radical operation should be at once completed.

Further, we should avoid operating upon cases that are clearly inoperable. The cases which are clearly inoperable are generally those which show metastases in the secondary group of glands, or in remote organs or structures. Whenever we find a secondary group of glands involved, such as those in the supraclavicular space or in the chest, the case is hopeless. Unfortunately in the past we have perhaps been a little too careless in neglecting a thorough examination of the patient, generally, to ascertain whether there were any symptoms of bone involvement or internal metastases.

Finally, our results will depend upon the adoption of a correct technic. Our present-day knowledge of cancer of the breast requires that he who operates must at least observe the following essentials: first, the removal of the complete breast; second, a large area of overlying skin; third, the removal of the entire pectoralis major muscle with its complete fascia, and, usually, for convenience, the pectoralis minor; fourth, all the glands, fat, and connective tissue surrounding the axillary vessels well up beneath the clavicle and down beneath the scapula. These essentials will practically leave the chest wall bare except for the intercostal muscles and the serratus magnus, from the clavicle above to the abdomen below, and from the latissimus dorsi behind to the middle of the sternum in front. Some may add, following the suggestion of Handley, the removal of the

fascia of the external oblique and rectus to the level of the umbilicus and to the midline. The value of this suggestion, however, has not yet been fully proven. So much constitutes an essential operation that one who is not capable of going thus far should not operate at all. Finally, if these *essentials* of technic can be observed and, at the same time, the wound can be closed with primary union and better function, the ideal is obtained. This ideal we believe the speaker's method presents. No plastic method, however, should stand in the way of the thorough removal of all infected tissues.

Dr. Arthur E. Hertzler (Kansas City, Mo.): Of the first three papers presented, the most pleasing statement was that made by the first essayist, Dr. Judd, to the effect that a large number of these tumors are benign. I am sure that if a greater degree of care were taken in diagnosis, a larger percentage of benign tumors would be discovered.

I thoroughly agree with the statement that all tumors should be removed when discovered, but,—it must be emphasized,—they must be tumors. Breasts are not infrequently removed for nodular hyperplasia. I have been amazed to find that a great many members of our profession do not know the palpatory findings of the normal breast. I believe every one should be compelled to investigate the normal palpatory findings of the human breast. If this were done it would lessen the labors of the workers in the pathological laboratories quite considerably.

Relative to the question of diagnosis, some surgeons seem to think the pathologist can diagnose any old thing that is sent to the laboratory. The pathologist cannot diagnose tumors any better than the clinician can, taking it for granted that the clinician is as well trained as is the pathologist. I am willing to back up any thoroughly trained surgeon—I say surgeon, and not operator—by saying that he can diagnose as many tumors of the breast, clinically, as the laboratory man would do with the microscope. I agree thoroughly with Dr. Judd that many of these tumors in women who have just passed the child-bearing period cannot be diagnosed except by the use of the microscope, and in this class the removal of the gland without the pectoral muscles is by all odds the proper procedure.

There are some other tumors that are extremely difficult to diagnose clinically, such as the very early tumors developing as fibro-adenomas, but these can be invariably diagnosed

by making a cross-section at the time of the operation. The objection to making sections at the operating-table has been very well set forth by Dr. Halsted, and I believe can be confirmed by everyone who has taken the trouble to go over this class of evidence. When the statement is made that all tumors should be removed when discovered, it should be likewise added that an operation commensurate with the findings should be undertaken.

The only trouble with the second paper—the paper by Dr. Stokes—is that the title is wrong. If it were called teratoma of the testicle, everything would be quite in harmony.

Dr. William Jepson (Sioux City, Iowa): I have been very much interested in the three papers that have been presented to us, two of which dealt with malignant lesions that occur in the female generative apparatus, and the other with lesions that occur in the male.

The present status of the cancer question is the following: if we go over the statistics we find that next to tuberculosis cancer claims the largest number of victims in the United States. This is not only true of this country, but of some European countries. We have nearly forty thousand deaths annually from cancer, and of this number nine per cent die of cancer of the uterus. This means that half of the cancers to which women are subjected are of the mammary gland and uterus. Furthermore, it means that one woman out of every twenty who have reached the age of forty years will die of cancer, and that in spite of the results we get from the removal of cancer, especially in the mammary gland. Local, state, and national societies have been organized for the purpose of acquainting people with the dangers of tuberculosis, but what are we doing as a surgical profession to acquaint women and men, especially women, with the dangers to which they are exposed by cancer? Very little.

Following up the thought presented by Dr. Hertzler, we as a surgical profession should not be so modest. We should try to palpate every woman's breast after she has reached the age of thirty-eight or forty, because it is unquestionably a fact that when a patient has a carcinoma of the breast the breast ceases to functionate, and that being the case, it is nothing more than a piece of useless skin. If a woman has a tumor in her breast when she reaches the age of thirty-eight or forty, and it apparently is increasing in size, that woman had better undergo the risk of having a piece of the integument removed even though it happens to be an innocent growth.

Dr. D. S. Fairchild (Clinton, Iowa): I think what Dr. Percy has said is generally accepted by the profession, and he has brought to us a very interesting discussion of an operation done upon cases that we have heretofore been inclined to leave alone. It seems that in a certain class of cases, where the cervix has become involved to a very great extent, we have been inclined to feel that we had better let them alone entirely on account of the risk we take of doing harm to the surrounding parts and the hopelessness of the case.

The doctor has exhibited an apparatus which apparently makes it possible for us to treat a class of cases that we have been inclined to regard as beyond the reach of any kind of surgical procedure.

In regard to the question of carcinoma of the body of the uterus, I think a somewhat different procedure would be the one that we should adopt, one which will give us results better than one would be inclined to expect from Dr. Percy's paper. We have found that when we make a vaginal hysterectomy in cases of cancer of the uterus, where the disease is confined to the body, by turning the uterus out and being careful that the cervix does not come in contact with any raw tissues, and putting on clamps from above down, and then dividing with cautery knife, we will get better results I think than Dr. Percy was inclined to give us credit for in his paper. These must be comparatively early cases. I think it is true that the results of operations for carcinoma of the body of the uterus are better than the results from operations upon the cervix for carcinoma; and yet we all feel that in cases that are operable, future results are determined by the question of extension of the infection to the pelvic glands. When these glands have become involved any operation of the kind which I have mentioned cannot be of any service. The Wertheim operation has for its purpose the dissecting out of these glands, and we must all come to see that an operation of that kind can be performed only by the most expert surgeons, without having a very high mortality, and so, it seems to me, the results altogether would be better from the use of some cautery means, as has been indicated by Dr. Percy, than by the general adoption of the more radical operation through the abdominal wall.

Dr. W. D. Haines (Cincinnati, Ohio): I probably could recite a case which would have some little bearing on the application of the cautery made with a view of controlling hemorrhage rather than curing the disease.

Eleven years ago a woman was referred to me who, at that time, was forty-six years of age. She had bled until it seemed that no operation was possible on account of her bad physical condition. Upon examination I found a cauliflower excrescence, somewhat larger than an English walnut, occupying the site of the cervix. We packed the vagina at the time, kept her in the hospital for a few days, and then I attempted to give her an anesthetic with a view to curetting this material away, hoping in that way to stop the hemorrhage. The case was clearly one that was inoperable, that is, so far as doing a complete hysterectomy or anything of that nature was concerned. I had the cautery prepared to check the hemorrhage, but not with a view to the application that Dr. Percy has made of it. In curetting away the material we had very little difficulty, because it was exceedingly friable. We cauterized, scraped away quite a quantity, ran the knife over it, and stopped the hemorrhage. We kept on in that way until we thoroughly cleaned up the entire cervix, and the part that extends up to the internal os was removed in that manner.

When the Secretary asked me to speak on this subject I recalled that case. I called up the physician by telephone and he told me that the patient is still living and well. I did not know what influence the cautery would have at that time, but, as I told you, it was used merely to stop hemorrhage, and not with a view to curing the disease.

I do not know that I can add anything further to Dr. Percy's results except to say that they are commendable. He certainly makes the end a little more comfortable for the patient by this method. Anything that will do away with a sloughing, with discharges, with the chronic sepsis that is going on, is to be commended. These patients are bad operative risks, and we are dealing with the terminal results of the disease. The symptoms so frequently put down in books with reference to adenitis, tumor and hemorrhage should be reserved for the protocol of the autopsy, and should not be spoken of as symptoms of cancer. We must find earlier symptoms if we are going to have good results in the surgical treatment of malignancy.

Dr. Walter B. Dorsett (St. Louis, Mo.): I want to say only a few words with regard to the paper of Dr. Percy.

As to the question of inoperability, where are we to draw the line? I have seen cases that have been turned down by physicians who said they were inoperable, and I have at-

tempted to do something for these patients, and I am glad to say that several of them operated on four or five years ago are still living. In my own mind I have settled the question this way as to the inoperability of these cases, and that is: if the anterior vaginal wall down low is involved, so that the bladder partakes of the infiltration, if the rectum is involved, I call that an inoperable case. Take a case in which the whole uterus in infiltrated, I do not consider it inoperable. About eleven years ago a patient was brought to me in whom I attempted to draw the cervix down with a pair of forceps and it tore off. I took another hold on it and the whole uterus dropped out. In that case I used simply the Paquelin cautery, and cauterized the rim, so to speak. That patient is living today, and I have a number of cases in which I have used the cautery, but not the cautery alone, but always after using the clamps I still use the cautery to cauterize those parts that I cannot include in the clamps.

I am now getting up statistics as to the locality from which cancer comes, which may throw additional light on this phase of the subject. I have observed a number of times, cases of cancer coming from a certain locality. In fact, it is very evident now whenever I hear of a case coming from southeast Missouri, down in the swamp district, I am almost sure that the case is one of cancer of the uterus or cancer of the breast. Just why this is so, I do not know. But these cases that I have used the cautery on, most of them from that section of the country, have had some degree of benefit and have lived considerably longer than if nothing had been done for them. I cannot agree with Dr. Percy in that there is not still a place for the use of the knife.

Dr. Miles F. Porter (Fort Wayne, Ind.): First, I would like to make a point that I think I have never heard made, and it is this, that there are cancers of the breast, and probably cancers of other organs, without tumors. A woman comes to you with a leaky breast; possibly that leakage is blood, possibly not, with absolutely no tumor, and yet sections show that she is the subject of cancer.

Again, the question of age should be emphasized. It is not only the old people who have cancers. They occur at all ages. I have operated on many, many carcinomata of the uterus and of the breast in women thirty years of age and under, and the most malignant carcinomata we have to operate on, other things being equal, are those that occur in the young, and the most malignant carcinoma of the breast is that seen

in nursing mothers, and those are especially malignant that are complicated by infection. So that I have come to this conclusion, that all that is said in text-books regarding the symptoms does not amount to anything. If you wait to make a diagnosis, you have waited too long to make an operation that will do any good. You can make a diagnosis, with the aid of the pathologist, by taking the tumor out, and if you are going to advise that in all cases you must, with young women, promise that the thing is not serious; that it will not produce any deformity. The incision can be made at any convenient point along the line or crease, the breast can be lifted up, and you can take the whole tumor and some of the surrounding tissue out and incise it, and if it looks carcinomatous to the naked eye, very well; hand it to a pathologist, and he will tell you whether it is malignant or not. If the report is unfavorable, then you can go on with the operation and remove the breast.

One other point in connection with the technic itself. I want to say again what I said some years ago, and I am more convinced now than then that it is true, because I have had longer experience, and it is this: we must be able to say to those women who come to us with carcinoma of the breast that the operation will not be serious; that they will not be laid up long; that their convalescence will not be long; that while it may be a little painful, it will not be distressing, and one of the sources of distress in these cases is the necessity of draining. The more cases I operate upon, the more firmly I have become convinced that drainage in the vast majority of cases after a radical breast operation is entirely unnecessary. It makes the convalescence all the more rapid and more comfortable for the patient if drainage is not resorted to.

Dr. Simon C. Beede (David City, Neb.): I would like to report a case of apparently simple adenoma of the breast in a young woman. I did not want to remove it, but she insisted on having it done because she said her mother had died of cancer of the breast, also her grandmother, two maternal aunts, and one paternal aunt. I removed it, and handed the specimen to a good pathologist and he pronounced it a carcinomatous degeneration.

Dr. Judd (closing the discussion on his part): Dr. Porter's remarks that no tumor may be present, and still there may be malignancy in the breast, prompts me to say that we have had a number of such cases. I recall one in which no tumor was palpable, yet the case turned out to be a distinct carcinoma.

When blood comes from the nipple it should be regarded with suspicion. We have yet to see a bloody discharge from the nipple without there being malignancy.

Dr. Percy (closing the discussion): Because of the time limit on the reading of papers, I have left out some helpful suggestions in carrying out the technic of this method. I wish the technic outlined could have been discussed more fully, because that is the point of my paper. Dr. Fairchild stated that cancer of the body of the uterus is rather rare. This is true. The larger number of cases of cancer in this region occur at the junction of the cervix with the body of the uterus; but those that occur in the body of the uterus, the adenocarcinomata, are very malignant, while the most malignant is where this form of cell is found in the cervical canal.

The little nodules extending from the uterocervical junction over the surface, or in the deeper structures of the vaginal walls, form the so-called squamous celled variety. This is not so malignant as the other two forms mentioned. It is in the destruction of this form of the disease in the vaginal walls that I have found the thermometer in the urethra useful. In the chart, I refer to this form of vaginal involvement as the "infiltrating" form, and that which grows exuberantly outward as the "vegetative."

There has been one important point brought out in the discussion, however, by practically all of the gentlemen; it is, that in the advanced cases it is absolutely useless to attempt anything with the knife, yet if you use the cautery you get not infrequently such results as have been reported here by Dr. Haines and Dr. Dorsett. I know, and you know, that if these cases had been submitted to the Reis-Wertheim operation, there would have been a rapid recurrence. I believe that this point is not only exceedingly important, but it is the nub of the whole situation.

I might say here what I did not say in my paper, viz., that it is possible that the electric cautery which heats the tip from the shaft, i. e., by contiguity, will be found to develop too great heat for the vacuum bottle. One of my speculums was broken from this great heat, while in the vagina. It is possible that the cartridge-shaped soldering iron, which I have found the best form with which to get the desired heat, when not using electricity, will eventually prove to be just as valuable as my electric cautery; although its action must of necessity be much slower, and, therefore, it takes more time

to do the operation than with the other form of cautery. The cartridge-shaped cautery iron is, of course, heated in a separate (usually gas) heater.

THE TECHNIC OF TUBAL STERILIZATION

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The subject of this paper was suggested by the action of the last General Assembly of the State of Iowa, which passed a law legalizing the sterilization of certain of its mental and moral delinquents by vasectomy *or by ligation of the Fallopian tubes,* the object being to prevent the transmission of the torch of life by the mentally and the morally unfit. The law specifically states that the sterilization of women shall be by ligation of the Fallopian tubes, but it is not specified whether the approach shall be by the abdominal or by the vaginal route, this point being left to the judgment of those whose duty it may be to carry out the provisions of the law.

The literature on this subject is very scanty in the English language, but relatively abundant in the German, and less so in the French and the Italian. We shall see that the framers of the Iowa law, as well as practically all American writers who have reported cases of tubal ligation, were not very familiar with the work done in Germany.

It is not my purpose to discuss the moral, the sociological, or the legal phase of this question, but I shall confine myself to the technic of tubal sterilization.

At the outset, I might say that many methods of tubal sterilization have been suggested, as simple division; single ligation with catgut or with silk; double ligation with catgut or silk, with or without interven-

ing division with knife, scissors, or the actual cautery, sometimes with a cone-shaped excision or destruction by cautery of the mucous lining of the tube; crushing one or more centimeters of the tube without ligation; double ligation with crushing between the ligatures; and crushing of the tube with ligation in the furrow. It has been suggested to close the divided ends of the tubes with musculomuscular, and seroserous sutures, with end-to-end approximation by additional seroserous sutures; the divided ends of the proximal segment have been ligated and buried under the peritoneum, or they have been brought forward and fastened in the wall of the vagina or in the inguinal canal. A rather dainty operation is that in which the serous covering of the tube is divided by an incision parallel with the tube, the oviduct pulled out and divided, the distal end of the proximal segment being buried in the folds of the broad ligament, the proximal end of the distal segment opening freely into the peritoneal cavity. Still more dainty is that in which an incision of three or four milimeters is made over the tube, two or three centimeters of the oviduct drawn out and excised, sutures not being necessary, as the divided ends of the oviduct recede, and a firm impervious cord remains. The mucous membrane of the uterus has been destroyed by means of steam. Earliest of all, was the suggestion to close the pars uterina of the tube by means of an intrauterine porte caustique, and later the actual attempt to accomplish the same end by means of an intrauterine galvanocautery.

The one efficient operation is the removal of all or the greater portion of the tube with the horn of the uterus, including, of course, the pars uterina of the tube, the uterine defect being closed by means of musculomuscular and seroserous sutures.

The tube has been approached through an anterior or a posterior transverse or sagittal colpotomy, through the inguinal canal, and by way of the median abdominal route.

I shall briefly review some of the reports on animal experimentation, next the results of ligation of pathological tubes, and, lastly, the results of the operations on normal human tubes.

Ronsse made a series of experiments on the tubes and on the bicornate uteri of rabbits, which he believed to fully prove that simple division, simple ligation, or ligation with division was sufficient to prevent conception. Further, he found that a cyst always developed laterad to the point at which the uterine cornu was ligated or divided without ligation. From these observations he concluded that the secretion in the cornua flowed toward the vagina. In the tube, a single ligature or a single division was never, but double ligation or double division was always, followed by hydrosalpinx. From this latter observation Ronsse concluded that the secretion in the tube passed either peripherad or centrad when there was a single ligature or a single division; but when two ligatures were applied to the tube, or when the tube was divided at two points, a cyst always formed between the two ligatures or between the two points of division, because, he concluded, both simple ligation and simple division, by sealing the end of the tube, completely and permanently prevented the passage of fluid, hence also permanently prevented the passage of ova and of spermatozoa. He believed that the fluid which accumulated in the tube was a normal secretion rather than the result of inflammation or disturbed circulation. These animals were all killed within a very short time after the operation, before the swelling incident to the trauma could possibly have subsided, and hence cannot be of great value.

Ronsse operated on six women, doing either a single ligation or a simple division, and in none of these six women had conception occurred within a year.

While the work of Ronsse is most interesting, it is difficult to believe that his conclusions are warranted, either by his experiments or by the results of his operations.

The animal experiments of Friedman are of a different type, and most interesting. In experiments 1 and 2, the tubes of a large rabbit were ligated with catgut. Six weeks later the animal was killed, and the ligatures had disappeared, the tubes were patulous, and fluid readily passed through them. In experiments 3 and 4, a large rabbit, the ligatures had cut through, and the tubes were patulous. Experiments 5 and 6 were on a grown cat. The tubes were crushed and ligated in the furrow, catgut being used in one case, silk in the other. Both animals were paired at the next season, and both had young. Experiments 7 and 8 were the same on bitches. Both animals were paired at the next season and both had young. In experiment number 9, a rabbit, the tubes were crushed and a ligature placed on either side of the crushing forceps; young followed the next mating. In experiment 10, a rabbit, the tubes were crushed with a smooth Langenbeck needle-holder. Conception was not prevented. In experiment 11, a rabbit; the tubes crushed, catgut ligature in the furrow, the animal was killed in six weeks; the tubes were not patulous. Experiment 12, the same as above; young after the next mating. Experiment 13, the same as above; young after the next mating. Experiment 14, a bitch; tubes crushed with difficulty, silk in furrow; mated two months later, young. Numbers 15, 16, and 17 were on bitches; with the same procedure, and the same results following the mating. Five similar experiments were with cats, with the

same results. Friedmann maintains that the proper crushing of the tube is a procedure of great delicacy, as it is easy to use too much force and divide the tube. These experiments are quite conclusive so far as rabbits, cats, and bitches are concerned, and they certainly tend to show that ligation is of very questionable efficiency in closing the tube in women. Friedmann had in view especially the function of the tube, while Fraenkel made careful study of the microscopic and anatomic results of his experiments.

Fraenkel made 33 attempts to close the tubes or cornua of rabbits by ligation, using silk, catgut, or a rubber band. In these 33 there were but two successes. In some cases the tubes were unchanged, and the ligatures were still attached to the tube by a short band of tissue, having simply cut through, the tube reuniting. Tubo-abdominal fistula resulted in many ligations, the ligature cutting into and opening the lumen of the tube. In 29 attempts to close the cornua, none were successful. In two double ligations of the tube there resulted three tubo-abdominal fistulæ. Feeling that he had demonstrated the fact that ligation, whether single or double, did not close the tube, Fraenkel next made a series of experiments with section, with and without ligation. In simple section, the lumen of the canal may be retained in both divided ends, or the continuity of the canal may be perfectly restored. Resection of from one to two and one-half centimeters of the tube usually resulted in double tubo-abdominal fistula. A series of experiments in which he cauterized the cut surfaces of the tube, or cauterized its lumen for a short distance, or cauterized the pars uterina of the tube, a patulous canal resulted in all cases. In 12 of 16 cases Fraenkel found adhesions between the bladder and the large or the small intestine. Hydrosalpinx was present in 26 animals. Fraenkel concludes as follows: "Our attempts to

close the tubes are discouraging. We have made perfectly well animals sick, and have exposed them to the possibility of a fatal illness. Our experiments on the cornua gave the same result." Fraenkel advises against ligation because of the liability of the knot to break into the tube, or the ligature may cut completely through the tube, leaving tubo-abdominal fistulæ. He says complete excision of the tube with a cone-shaped excision of the pars uterina, with careful suture of the uterine defect, is the only safe procedure.

Kossman tells of his experience in ligating the oviducts of young pullets, which began to lay six weeks later, the ligatures having become encrusted with lime salts and broken.

All of these animal experiments, except those of Ronsse, indicate that ligation is an entirely inadequate procedure, and that ligation with division or excision is but little safer.

I shall next refer, briefly, to the results of ligation, with or without excision of a portion or all of the tube, incidental to operations on women undertaken for pathological conditions.

Ries reports three cases in which diseased tubes had been removed, and in all of which, at a second operation some months later, the tubes were patulous without a trace of ligature. Braun-Fernwald reports Falaschi's experience, the ligation of both tubes in connection with a Cesarean section, with subsequent pregnancy.

Gordon reports two cases in which the operator removed both ovaries and both tubes, but pregnancy followed in both cases, in the one about three years, and in the other fifteen months after the operation. Gordon remarks that "some ovarian tissue must have been left, but how did the ovum reach the uterus?" The ligated tubes must have become patulous.

Sutton reports a double ovariotomy, the right tube being divided with a cautery and ligated close to the uterus, the left tube was divided with a scissors and ligated close to the uterus. The patient was delivered of a child about twenty months later, and of a second child about twenty months after the first. Of course, a particle of the ovary must have been left.

Dudley reports three living children, and three women now pregnant from whom he removed one-half of the tubes and a portion of the ovaries. Dudley does not state that he ligated the tubes.

Schmidt ligated and removed the left tube and the left ovary, and all of the right tube except one and one-half centimeters because of hydrosalpinx. Pregnancy occurred several years later.

Belser reports a case in which Zweifel made a double ligation and intervening division of both tubes, with subsequent pregnancy. Pape (Belser) reports a double ligation with division of the tubes. Some months later the uterus and tubes were removed because of hemorrhage incident to an abortion. A careful anatomic and microscopic examination demonstrated that the tubes had reunited in the most perfect manner (tadellos zusammen geheilt). Belser's case from the Zurich clinic is instructive. As an incidental operation, both tubes were double ligated and divided. Some months later, the woman was operated on for a tubal pregnancy.

In connection with a second Cesarean section, Abel made a double ligation of both tubes with intervening division. The third Cesarean section was done three years later, both tubes having reunited, one of them being permeable throughout its entire length.

Pissemsky demonstrated two tubes which had been ligated with silk after a first Cesarean section; after the second Cesarean section both tubes were removed

and one was found closed and the other patulous, both ligatures being in place.

Vecchi reports a most interesting experience. Incidental to a Cesarean section, he ligated both tubes with strong Florence silk, drawing the knots tightly, to surely occlude the lumen of the tube. Eight months later the patient was again pregnant, and at the second Cesarean section, feeling that a tubal ligation did not suffice to prevent conception, Vecchi removed the tubes and the ovaries, which gave him an opportunity to make a careful microscopic study of the results of the previous tubal ligation. He found that both sutures had cut through the tube, that the loops of silk were intact and that the divided ends of the right tube were sealed over with peritoneum, but that the left tube had reunited and was patulous throughout its entire length.

McWalter reports a case in which lactation and menstruation continued, with a brief cessation, after the removal of both tubes and one ovary, an observation not surprising, as tubal ligation does not interfere with menstruation.

Fritsch, in connection with a laparotomy ligated both tubes, using silk, and drawing the sutures very tight. The woman became pregnant three years later.

Lambach, incidental to an operation for retroversion, ligated both tubes with silk, drawing the knots very tight. Term pregnancy occurred three years later.

Allen removed a large ovarian cyst on one side in a woman of thirty-two and ligated the tube with silk on the other side. Term delivery occurred fifteen months later.

These results of the removal or ligation of tubes incidental to other operations are but typical, are quite well known, and are appreciated by surgeons, and they

only confirm the animal experiments of Friedman, Fraenkel, and others.

Before taking up tubal sterilization as an independent operation, I wish to refer to sterilization by atmocausis, or the destruction of the mucous membrane of the uterus by means of steam at a temperature of 105° to 115°. This procedure is especially recommended by Cramer. The mucous membrane of the cervix must not be destroyed, but all parts of the mucous membrane of the body of the uterus must be reached. He tells of bad results, of severe colic, necessitating a hysterectomy, etc. He closes a long article by stating that this is the best method of producing sterilization, especially in tuberculosis and in heart disease. Pincus and Baisch recommend the same procedure. Cramer reports five cases, three for tuberculosis and two for heart disease.

The first independent operation for tubal sterilization was performed by Koch, in 1878. His thought was to bring about a closure of the pars uterina of the tube by means of an especially constructed intra-uterine galvanocautery. Without dilating the cervix, he introduced this cautery into the tubal angle of the uterus and applied the current for 45 seconds, hoping to so cauterize the uterine part of the tube that subsequent sloughing and contraction would efficiently seal the same. Koch himself stated that the efficiency of the method was not proven, since subsequent failure to conceive may well have been due to other causes. This method found no imitators, and most rightfully so, because it should seem very difficult to accurately estimate the actual effect of such a galvanocautery.

Kehrer, in 1897, performed the first independent tubal ligation involving the peritoneum. His approach was by way of an anterior colpotomy. He placed two ligatures about the tubes, one quite close to the cornu, with intervening division. There was considerable

hemorrhage from the uterus in one case, requiring several sutures. There was slight collapse after the operation. Kehrer recommended the procedure for certain physical conditions which made pregnancy a very serious matter. In this first paper he reports but one operation. Later, he reported another, both patients subsequently becoming pregnant.

Spinelli, the first Italian writer to take up the subject, one year after the appearence of Kehrer's article in Germany, suggested that the peritoneal cavity be entered by way of a posterior transverse colpotomy. A forceps guided by the index finger served to bring the tube into view. If normal, a silk ligature was passed about the tube; if diseased, the tube was excised and a ligature placed about the uterine end. Another method suggested by Spinelli was to enter the peritoneal cavity by way of an anterior sagittal colpotomy, two ligatures to be placed about each tube, with intervening division. If diseased, the tubes should be excised.

Van Meter states that in his first operation for tubal sterilization he placed a single ligature on one tube, and two ligatures on the other tube with intervening division. Later, he ligated the uterine end of the tubes only, leaving the distal end free. In what he terms his perfected operation, he makes a little slit over the tube, hooks up the oviduct, divides the same, covers the uterine end with a few catgut sutures, and leaves the other end free in the abdominal cavity.

Werner, in a very brief article, insists that double ligation of the tube with excision of one or two centimeters between the ligatures suffices to prevent conception.

Morris, at a clinic, presented an 80 lb. patient whose sufferings were such during two pregnancies that neither she nor her husband desired a repetition. In answer to a question propounded by himself, "What

can we do that is morally right? He answered, "Tie a silk thread about each oviduct near the fimbriated extremity, and the ligature will become incapsulated and close the oviduct. If, later, the patient wishes more children, we can easily make a simple abdominal incision, and a simple splitting of the closed end of the oviduct will free it again for action."

As already intimated, American writers on this subject seem blissfully unfamiliar with the many failures of tubal ligation in Germany.

Kirschoff suggested the most dainty procedure of all. He would make a very short incision through the peritoneal covering and parallel with the tube, and then with a forceps or a hook he would draw out three or four centimeters of the oviduct and excise the same. Sutures are not necessary, and subsequent conception is impossible, as a firm fibrous cord is said to result.

Fritsch applied two ligatures with intervening excision. His experience in a prior case had taught him that a single ligature is inefficient.

Arendt performed 16 tube-ligations in connection with vaginal fixation, using silk or formaline catgut. Pregnancy soon followed in one of these cases. Arendt concluded that simple ligation is not safe. If undertaken as an independent operation, he would enter the abdominal cavity by way of a posterior colpotomy. Arendt had not operated on the tubes to prevent conception except in connection with vaginal fixation. He does not consider ligation safe.

Rühl insists that neither the operation of Kehrer, double ligation with intervening section, or that of Fritsch, double ligation with intervening exsection, sufficed to prevent conception, but added the danger of extra-uterine pregnancy. Rühl removed both ovaries and tubes, ligating the latter with silk. Two years later he reopened the abdomen and found the end of

one tube wide open. With the ovaries remaining, pregnancy would have been probable and extra-uterine pregnancy possible. For these reasons, Rühl suggested that the divided ends of the tubes be fixed into the vaginal wall, either in the median colpotomy incision, or in the smaller lateral incision, if the tube ends were too short to reach to the median incision. This procedure would give spermatozoa an opportunity to make the round, ultimately returning to the vagina. It ought to be efficient, but has been called unphysiological and has not been intimated.

Halban, in a Cesarean section, opened the uterus by means of a transverse incision, removing two or three centimeters of the tube at the same time, covering the ends with peritoneum.

Casalis reports a case in which he crushed both tubes from the vagina, using a pair of very strong pressure forceps; the woman was pregnant six months later.

Friedman crushed the tubes and ligated with catgut in the grove, believing that the lumen of the tube could not be restored.

Kossman does not consider single ligation of the tubes efficient, but would divide with a cautery. If the division be made with a knife or a scissors the mucous lining of the tube will protrude, preventing closure, an opening will remain, and the passage of ova and spermatozoa will not be prevented. Kossman does not believe that Rühl's method of sewing peritoneum over the tube is safe, but that division with the cautery is the most efficient. Whenever possible, he advised the crater-like destruction of the mucous membrane of the tube with a cautery designed for this particular purpose.

Asch states that every possible surgical means has been suggested to prevent conception, from the artificial growth of a polypus in the cervix to a panhys-

terectomy. Asch would grasp the tube with a forceps at the junction of its inner and middle third and place a ligature on either side of the forceps, the ligature in the outer side of the forceps to be returned under the tube and tied to control hemorrhage, but not including the tube. The ligature on the inner side is tied to occlude the tube. The layers of the mesosalpingium should now be separated and the uterine end of the tube buried by passing the two ends of the ligature from the freshened toward the serous surface, one in either direction. Subsequent traction and ligation would draw the tube downward and close the peritoneum over the same. Asch prefers to approach the tube by means of a posterior sagittal colpotomy, sometimes by an anterior colpotomy.

Menge, in severe prolapse of the uterus in which he considers it advisable to perform an Alexander Adams operation, suggested that the distal half of the tube be excised through the inguinal canal, and the ends of the remaining part be fastened to the aponeurosis of the external oblique muscle in the inguinal canal. Blietz reported six such cases, operated on by Menge and Kroenig.

Neumann, after commenting on the failures of ligation and excision, tried to improve the technic by grasping the tube near the uterus with a Pean forceps, making traction and so directing his knife as to remove a wedge-shaped piece of the cornu of the uterus with the entire pars uterina of the tube. The smooth defect in the uterus is to be closed with a running catgut suture, and the remaining portion of the tube attached over the line of sutures to make the closure more sure.

Offergeld states that ligation is entirely unsafe (vollig unsicher). Double ligation with division between the ligatures had been followed by many failures and also some success. The material used is a matter of no

moment. The operation is not free from danger because of possible adhesions and cystic degeneration of the uterine portion of the tube. Offergeld next tried double ligation with excision of the tube, which was followed by many failures, even when the ends were covered with peritoneum. Offergeld does not consider the method of Kirchoff, subserous removal of 3 or 4 centimeters of the tube, as effective. Excision of the tube with destruction with a thermocautery is not efficient. The amount of the tube removed is immaterial. Offergeld states that division of the tube with burial of the end under the peritoneum (retroperitonealer Versenkung) has been followed by so many failures that the method is not safe. Fixation of the tube in the inguinal canal in connection with the Alexander Adams operation is mistrusted, because the end may become loosened. Offergeld condemns atmocausis.

Neumann, Pfannenstiel, Fraenkel, and others suggest that the uterine end of the tube be removed with a deep wedge-shaped piece of the uterus, the uterine defect to be closed with musculomuscular and seroserous sutures. Excision of the tube with the wedge-shaped piece of the cornu through a posterior colpotomy is associated with severe hemorrhage, and the suturing is very difficult. Through an anterior colpotomy the hemorrhage is also severe. Offergeld prefers the abdominal route. The section or the excision of a portion of the tube between the ligatures may result in tubo-abdominal fistula, making conception possible. Single ligation or double ligation of the tube with intervening division or excision give no guarantee of success.

Vecchi reports a case of double ligation of both tubes, the ligature being drawn tight, incidental to a Cesarean section. A second Cesarean section being necessary one year later, Vecchi removed both ovaries and both tubes. He found that both ligatures had

cut through, the loops being intact, but on one side the canal was patulous. Vecchi's patient had suffered from infantile paralysis in early youth, both lower extremities having been involved. Recovery on one side very complete. There was also some pelvic deformity which made Cesarean section necessary.

Tussenbroeck, Kouwer, and Treub object to tubal sterilization as an independent operation, comparing it to the consutio and to the infibulation of barbarous times.

Reifferscheid and Chrobak advised total extirpation of both tubes.

Rissman reports a case in which he entered the peritoneal cavity by way of a posterior sagittal colpotomy, in which pregnancy had not followed. He noted that peritoneal sutures are apt to separate, that the wedge removed from the uterus must be deep enough to remove all the tube, the muscular layer of the uterus must be brought together, and two layers of sutures must be used, a musculomuscular and a seroserous.

Küster insists that the desire of a patient to be sterilized can never be a sufficient reason. He never operates unless pregnancy is a serious menace to life. He tells of two cases in which he removed three centimeters of the tubes with cone-shaped excision of the cornua. The hemorrhage was severe, and the uterine cornua were sutured, but both cases were followed by pregnancy. Küstner chides himself for having heeded the wishes of the patient to operate from below. He prefers the abdominal route. The only efficient method is to excise the tube, including a deep cone-shaped excision of the pars uterina, the uterine defect being closed with musculomuscular and seroserous sutures.

In regard to the place which tubal sterilization should occupy, local surgical conditions aside, I can

recall but two cases in my own practice in which this procedure should have been seriously considered. The one was a deformed imbecile upon whom a Cesarean section was done; the other a young woman whose first pregnancy, a term-pregnancy, had been complicated by a paresis of all four extremities; and her second, an interrupted and fruitless pregnancy, by a paresis of like distribution amounting almost to paralysis, from which she has not fully recovered in a year. To sterilize a woman because she has tuberculosis or a heart-lesion, seems repugnant. I am not a sociologist, and shall not discuss the right of the state to sterilize its delinquents, although I am not convinced that it has such a right.

I should conclude:—

1. That animal experiments, the ligation or excision of pathological tubes, and the results of like operations on normal tubes, prove conclusively that tubal ligation, with or without excision, is not an efficient measure to prevent conception.

2. The only operation which gives a promise of success is excision of all or a part of the tube with a deep wedge-shaped excision of the uterine cornu, including the pars uterina of the tube, the uterine defect to be closed with a musculomuscular and a seroserous row of sutures.

3. The anterior abdominal approach is the easiest, the simplest, and the safest.

4. Granting that the state has the right to sterilize its mental and moral delinquents, tubal ligation, as legalized in Iowa, considering its remote possibility of success and its ever-present, although vanishing, danger, is an unjustifiable operation, entirely without promise as a means to lessen the procreation of the unbalanced.

5. In medical practice, tubal sterilization is but rarely justifiable, because it does violence to the most deeply rooted of all instincts, after that of self-preservation.

6. Considering the almost fiendish pertinacity with which the female economy conserves the function of the Fallopian tubes, the efficiency of vasotomy or vasectomy may also be questioned, unless Kipling be right when he says:

"But the woman God gave him, every fiber of her frame,
Proves her launched for one sole issue, armed and engined for the same;
And to serve that single issue, lest the generations fail,
The female of the species must be deadlier than the male."

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END-RESULTS IN GALL-BLADDER SURGERY

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As long as cases of gall-bladder surgery are dismissed at the outer door of the hospital, little will be known of the end-results. Until the average condition of patients, two, five, or ten years after operation, is known one cannot intelligently advise operation, except in cases of dire necessity. Unless the life of the subject of gall-bladder disease can be shown to be more comfortable on the average after operation than before, he might better endure his ills as best he can and avoid surgery. In fact to make a good case for the numerous operations made on the gall-bladder it must be shown that the ratio of comfort and good health following these operations is more than enough to offset the danger, pain, loss of time, and the pecuniary cost that they entail.

For a number of years the writer has been impressed with the meagre information at hand relative to the final fate of those who have been subjected to the varied surgical procedures practiced on the gall-bladder. An effort has been made to keep in touch, as far as possible, with patients of this class. As an aid to this they are encouraged to report for examination, when possible, and to inform me through their physicians should any untoward symptoms arise.

By correspondence and by personal examinations and interviews I have been able to gain a fair knowledge of the post-operative condition of 234 cases for periods ranging from six months to twelve years following their operation. Of this number there are 60

males and 174 females, or approximately three females to one male.

Of the 234 gall-bladders of which the record is made, 150 contained stones and 84 were cases of cholecystitis, acute or chronic, without stones. At the primary operation 176 were drained and 58 were subjected to cholecystectomy. Only one of the 58 cases on whom cholecystectomy was done primarily has had enough post-operative trouble to require relief by secondary operation, and that was done to break up adhesions that were interfering with the emptying of the stomach. Relief was complete eighteen months after the operation.

Of the 176 cases of primary drainage 11 have been such sufferers as to be willing to have another operation performed. The second operation in 10 of these cases was cholecystectomy with relief finally in all of them, but at least 2 of these continued to have considerable pain for several months. One of the cases operated on a second time did not seem to show sufficient cause for cholecystectomy, and a drainage operation was done. The relief was only partial.

Aside from the 11 cases operated on secondarily for unrelieved or recurrent symptoms, 5 have been readmitted to the hospital for medical and massage treatment without operation. Two of these patients were relieved by the hospital treatment, and two received no benefit and are still suffering. The fifth case has been back twice and each time rest, hot packs, Carlsbad salts, careful diet, and light massage have given relief. His last stay in the hospital was only three month ago, and it was agreed that if the symptoms return he will come back for a cholecystectomy.

Besides the 5 cases just mentioned that returned to the hospital for treatment I have records of 12 other cases that complained greatly for a time, but, as far as

it has been possible to ascertain, most of them are better and at least 7 are completely relieved.

My records in regard to persistent fistulæ are incomplete, but several have not closed for three to six months after operation. One of these was still discharging almost a year after the patient left the hospital, but as there was no pain and the general health was excellent the woman would not consent to another operation.

Another persisting mucous fistula was operated on a second time and is one of the group of 11 cases already mentioned. Her pain was very severe whenever the fistula became temporarily closed, due evidently to the tension produced by the retained mucus. Occlusion of the cystic duct was found and cholecystectomy gave complete relief.

As nearly as it has been possible to learn the post-operative history of my cases an encouragingly large number are practically relieved immediately and completely as soon as they recover from the operation. Occasionally, a patient who has been comfortable while lying in bed begins to have pain and a dragging sensation as soon as he begins sitting up. Others leave the hospital feeling perfectly well, but begin to have more or less discomfort in the region of the gall-bladder as soon as they begin to move about actively.

Without definite figures on this point I would estimate that 25 to 30 per cent of cases have varying degrees of discomfort from only a slight feeling of uneasiness to pain severe enough to disable them for a time. The great majority of such cases completely recover in from one to six months.

Post-operative pain was much more frequent a few years ago when ventrosuspension of the gall-bladder was practised in all drainage cases than it is now. But even without attaching the fundus to the anterior ab-

dominal wall the presence of the drainage-tube produces a more or less intimate adhesion, which must occasionally produce pain and discomfort.

To enumerate all the causes which may produce post-operative symptoms is not easy. A few of them have been very instructive and have led to certain changes in procedure in order to avoid them. They are as follows:

1. With a dense attachment of the fundus to the abdominal wall high up the weight of the liver pressing downward is doubtless often productive of post-operative pain and dragging. In the course of time the adhesions stretch, or the parts accommodate themselves and relief is obtained.

2. Pericystic adhesions are often the cause of much distress. For several years it has been my practice to remove gall-bladders if their walls are denuded of peritoneum, they being certain to form new and dense adhesions.

3. Unless the cystic duct is patent, and likely to remain patent, the gall-bladder is certain to cause future trouble. If a stricture of the cystic duct already exists at the time of the operation, or if a stone is tightly impacted in the cystic duct, a condition certain to cause necrosis of the mucosa and ultimate stricture, I believe the viscus should always be removed.

4. Should the gall-bladder be very thick-walled or distorted, or denuded of patches of mucosa, or if the wall is fibrous, it is in a condition which will always invite stagnation of bile, and such a condition is sure, sooner or later, to cause trouble. Gall-bladders of this description are a menace and should be removed at the primary operation.

5. Whenever the gall-bladder is in a condition favorable to normal function, as manifested by an elastic wall, a patent cystic duct, a normal peritoneal cover-

ing, and an intact mucosa, it should be retained. The great majority of the cases operated on reasonably early in the disease need not be sacrificed.

6. Another frequent cause of incomplete relief of symptoms is chronic pancreatitis. It is a very frequent complication of gall-bladder disease, and should be looked for at every operation. If present the drainage of the gall-bladder should be continued for several weeks, or until the condition of the digestion is as nearly perfect as possible.

The result of my research in the cases I have been able to trace has been far from discouraging. In fact the percentage of cases with really unsatisfactory results is so small, only twelve per cent, and half of these were relieved by secondary operations, that it seems to me surgeons have a right to recommend earnestly operation in all cases of severe disease of the gall-bladder not promptly relieved by internal treatment.

As experience increases no doubt the number of cases not relieved will grow fewer. A more mature judgment will discriminate with more certainty between the gall-bladder that should be drained and the one that should be removed.

One noteworthy observation has been made. In two instances I have discovered that stones had been overlooked at the time of the operation, and they have been removed at a secondary procedure. But only once have I found stones to have reformed after operation. This occurred in a case, not mine, at the primary operation. She was sent to me complaining of even more severe symptoms than before her first operation, a year before. I found three chromic catgut sutures in her gall-bladder, they apparently having been used as purse-string sutures. Each one was studded with stones like beads.

The reason stones are not likely to form again is apparently that a definite infection is necessary to produce them. After the long stormy experience from the primary attack till relieved by operation, a condition of relative immunity is evidently produced. We can therefore speak rather positively to patients contemplating operation and promise them that reformation of stones is exceedingly unlikely.

In a paper on this subject read before the Surgical Section of the American Medical Association at the Los Angeles Meeting in 1911, by Dr. E. M. Stanton, of Schenectady, New York, a distinction is made between the cases of stone and of cholecystitis. Although in the main in hearty accord with the conclusions he reached, I cannot agree with him that the results in operation for stone are better than when cholecystitis is present without stones. My results have been practically the same in these two classes of cases.

The fact is that operations are not done simply for the purpose of removing stones, or mucus, or precipitated cholesterin, but to relieve the patients of their pain and disability, which are not due to what happens to be in the cavity of the viscus, but to the condition of the gall-bladder wall, or the duct-wall. If the walls are healthy the stones do not harm. If it were possible to render the walls healthy without removing the stones or precipitated cholesterin, the symptoms would disappear. Thousands of people are carrying around gall-stones formed years ago after a gall-bladder infection and do not know it because they are perfectly comfortable. The infection no longer exists, and they are to all intents and purposes well.

I cannot forego saying again at this time what I have said several times before, that a patient should not be dismissed from the hospital as cured after an operation. The real cure takes time and is rendered much more rapid and certain by careful diet, moderate but

regular exercise, and Carlsbad salts, kept up for months. And after finally dismissing the case instructions should be given that at the least hint of further trouble in the vicinity of the liver or gall-bladder region recourse should at once be had to another Carlsbad cure.

THE CHOICE OF TECHNIC IN ENTEROSTOMY INCIDENT TO OPERATIONS FOR INTESTINAL OBSTRUCTION

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The advantages and value of drainage of the obstructed bowel are recognized and generally conceded; and, though it has been infrequently used and accepted, for ages, only as a *dernier ressort,* it has not been until more recent years that, in the evolution of modern surgery, it has been brought to an established place. While the broad principle of intestinal drainage has become established, the methods of its application have been numerous and varied, and there are very many methods of its application that are undesirable, in that they deter from the general adoption of the best methods. Each operator should select a method which he can utilize to the best advantage to himself and his patient. Among the many procedures there should be a choice in technic, varied somewhat, of course, in accordance with the skill and surrounding of the operator, and the case in hand. The writer has therefore thought it desirable to analyze the various methods of performing enterostomy, with a view of narrowing the choice of technic to reasonable limits, and also to seek to simplify its application, render less formidable its undertaking, minimize its objectionable features, and thus favor its more frequent and early use; and also to render more uniform our practice, improve our skill, and thereby lessen mortality.

The primary object of enterotomy having been to save life, its earliest use entailed little or no other consideration, if we are to judge from the crude methods in general use from its inception to within very recent years. The objectionable features of ordinary enterotomy, however, brought efforts to curtail them; hence the newer term *enterostomy* for procedures contemplating a permanent fistula. Within recent years, however, there has been a distinct tendency to eliminate the permanent character of the fistula by establishing drainage of the bowel temporarily, which may be made to close at will upon the withdrawal of the tube, which serves to temporarily maintain patency.

The old operation of cutting into the gut—enterotomy has become by refinement in technic the modern enterostomy. This was recommended by Lewis in 1757, introduced by Renault in 1787, and revived by Nelaton in 1840, and in our generation denominated by Treves "an uncouth measure." He also spoke of it as a "rough and ready" operation. Purse-string suture of a drainage-tube into the intestine is frequently mentioned in literature, but the use of multiple purse-string sutures to obviate subsequent repair is infrequent, and they are evidently used by but few. This procedure is so relatively simple, safe, and satisfactory that it would seem to warrant its more general utilization.

Realizing as I do from my limited observation and familiarity with the work of others that the technic is not borne in mind, and hence not very generally practiced, I am again, and for the third time, presenting this matter for the consideration of this thoroughly representative body of distinguished surgeons.

For several years the writer has utilized enterostomy in connection with many of his operations for intestinal obstruction. At first he had been content, as

were our forefathers, simply to incise a withdrawn loop of bowel (enterotomy). Later a rubber tube was secured in the bowel. Then followed the suggestion of Stewart, and a Murphy button was used with a tube attachment. After this the Paul tube, so popular with the English, and eventually the smooth firm rubber tube or large-calibre catheter was introduced and maintained on the Kahder principle. Finally, however, came the adoption of the multiple purse-string invagination about a catheter after the manner of an E. J. Senn gastrostomy.

The disadvantages of any method that does not control the fecal stream and prevent soiling and excoriation are fully appreciated, and the precipitation of this condition can only be justified as a purely life-saving measure, and then only in the hands of those whose technic is too limited to admit of attempts at refined methods. The withdrawn bowel, secured and surrounded by gauze, soiled with feces, and with endothelium destroyed, is a condition sometimes seen, but never justified among the skilled. To correct this by the free use of vaseline is but a sorry makeshift. The rubber dam surrounding the loop, as suggested by Levison, of San Francisco, falls short of meeting the full indications. The methods of Paul and his glass tube, and of Stewart with the Murphy button and attached tube, have the objection that they control for but a very few days at most; besides, they will destroy a portion of the lumen of the gut and they have the old disadvantages of an exposed bowel. Furthermore, a secondary operation is required.

The Moynihan method of enterotomy and drainage by a special tube introduced into the bowel, which is made to pass over the tube so that inches of tube negotiate feet of bowel, and thus by two or three introductions the bowel is thoroughly emptied, is a very valuable method and will suffice in some cases. It has

been observed by the writer, however, that a bowel distended from paralysis will rapidly refill with gas, and this gas-distension is inimical to the security of the sutured enterotomy openings. In many cases more prolonged drainage is required. And this theoretical objection has suggested itself, that damage may readily result to the lumen of the gut, which would likely favor the absorption of the highly toxic and septic bowel-contents.

Trocar punctures and aspirations have been extensively used; the former more especially for enabling the operator to replace intestines which it would be impossible to return to the abdominal cavity without deflation, but the temporary benefit has seldom been compensation for the damage necessarily resulting. Aspiration through a special sleeved trochar with a suction apparatus as devised by Klapp, would seem to have the inherent disadvantages of all special apparatus to be used in emergencies.

The conditions indicating enterostomy without further immediate operative procedure are pronounced collapse, extreme toxemia, marked exhaustion, and impending dissolution. Such subjects had best be operated on under local analgesia, usually the median-lateral incision midway between the umbilicus and the pubes. The first presenting distended loop of bowel is grasped and deflated either by finger-pressure or by suitable rubber-covered clamps. If the bowel is too distended or too altered to admit of this, then it is desirable to puncture the bowel with a needle or very fine trochar to allow gas to escape in sufficient quantity to permit the segment being operated upon without danger of leakage. A very distended bowel will leak through stitch-holes. The purse-strings of No. 0 catgut, one-eighth of an inch apart, are introduced by means of cambric needles and the first part of the knot is then made. A stab is made in the gut by a

sharp-pointed knife, care being taken not to cut the catgut. A large-sized rubber catheter with extra fenestra is introduced two inches into the opening, which should grasp it tightly. The catgut sutures are then tied, the gut is encouraged to empty if the patient's condition should permit, and the intestine is returned. The peritoneum is sutured to the gut and is closed about the catheter. The abdominal wall is closed in layers with catgut and retention sutures of wormgut. The ends of one wormgut are used to secure the catheter against withdrawal, and the wound is dressed as in any similar wound. The catheter is made to drain into a large bottle, which should be frequently emptied, rather than depend upon a long drainage-tube into a vessel under the bed. Such an arrangement might result in the catheter being accidentally withdrawn. Any clogging of the catheter may be relieved by introducing salt solution; indeed, the frequent introduction of salt solution is desirable and should be diligently performed. Introduced hot it is a most efficient means of combating collapse. The catheter may be removed in from three to six days, and is not, as a rule, followed by leakage. It may be reintroduced from time to time as necessary; of course, sufficiently often to prevent closure by healing until normal defecation has taken place. The writer has frequently experienced the necessity for reintroducing the catheter to relieve gas and to drain the bowel. Thus its value has been repeatedly demonstrated in individual cases. There will be less likelihood of subsequent leakage, probably, if the tube is removed at intervals after about three days. The effects of decubitus may be sufficiently prejudicial to affect the competency of the valve. These principles are observed to advantage in gastrostomies and in cystostomies.

The slight leakage occurring in some cases soon ceases, as a rule, and no secondary operation for closure of a fistula has been necessary. Twice it has been necessary to inject very small fistulæ with nitrate-of-silver solution by means of a hypodermic syringe. Single treatments in each case resulted in permanent closure. As yet it has not been necessary to free the bowel from the abdominal wall because of later obstruction. There are four of these cases, two of them having disquieting symptoms from time to time. They were sufferers from suppurative appendicitis and extensive peritonitis, and it is probable that other adhesions are responsible for the slight recurring disturbances.

In certain cases of enterectomy and enterorrhaphy, enterostomy by the purse-string invagination method may serve as a safety-valve, and save the necessity of an untidy external drainage of the bowel. This may be practiced with the view of lessening the high mortality of a completed, radical, primary operation. Resections of the colon will illustrate. Some of our best authorities recommend two-stage operations in resections of the large bowel, more especially of the transverse and descending colon. This thin, parchment-like portion of bowel is especially prone to leakage after suture, both because of its inherent unfavorable structure and because the large intestine is a reservoir for solid feces and gas, the latter being especially prejudicial to healing, because of the pneumatic distension occasioned by its presence and its more or less constant interference with rest in the parts. Ballooning and the tension induced thereby is most inimical to success in healing of the large bowel. These conditions can be met and overcome by the venting of gases by the means of rubber-tube drainage of the bowel according to the technic herein advocated.

In those cases of obstruction unrelieved but which have been primarily drained to bridge them over, and have an intestinal fistula to be repaired, or possibly a resection with anastomosis or enterrorhaphy in softened tissues unfavorable to suture, the venting of the bowel by an enterostomy lessens the element of risk. The catheter may be removed and reintroduced at intervals to relieve distension and possibly recurring obstruction and render healing more certain.

The subject under discussion is the choice of technic in operations incident to intestinal obstruction. Therefore, the principles governing the indications for enterostomy have been recited because they indicate the choice of technic. The simplicity and safety of the method favored by the writer make its indications more frequent, and if it were more often used and had a more general early application, it would, in his opinion, make for safer and more satisfactory intestinal surgery incident to operations for obstruction, both acute and chronic.

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Ground, Wm. E.
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